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NEW MATRICULATION GEOGRAPHY

BY

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CONTENTS.

PART I.—PHYSIOGRAPHY

I.—THE EARTH AND THE SEASONS.

PAGE.

Position of the Earth in Space 1
Shape and Size of the Earth 2
The Zones, etc. 6
Motions of the Earth and their Effects .. 7
Exercises 15

II.—LATITUDE AND LONGITUDE.

Fixing position on a plane 17
Fixing position on a sphere 18
Meaning of Latitude and Longitude .. 19
How to find Latitude 21
Local Time 22
Standard Time 25
How to find Longitude 26
The Date Line.. 28
Exercises 30

III.—REPRESENTATION OF THE EARTH.

The Globe and the Map 32
Projection 33
Kinds of Projection 34
Contours and Hachures 40
Scales 41
Exercises 42

IV.—THE MOON AND THE ECLIPSES.

PAGE.
PHASES OF THE MOON 44
MOON-RISE AND MOON-SET 46
SOLAR AND LUNAR ECLIPSES 47
THE SOLAR SYSTEM 49
EXERCISES 50

V.—LAND, AND AGENTS OF LAND CONFIGURATION.

CRUST OF THE EARTH AND ITS TEMPERATURE .. 52
ROCKS, THEIR FORMATION AND KINDS 52
AGENTS OF CHANGE (INTERNAL) 54
EXERCISES 60

VI.—EXTERNAL AGENTS OF CHANGE.

RAIN, SPRINGS AND WELLS 61
ACTION OF RIVERS 64
ACTION OF ICE, ETC. 66
EXERCISES 69

VII.—THE OCEAN AND ITS CURRENTS.

SEA-WATER; ITS SALTNESS AND TEMPERATURE .. 70
MOVEMENTS OF THE OCEAN 71
CAUSES AND KINDS OF CURRENTS 72
THE CURRENTS OF THE GREAT OCEANS 74
INFLUENCE OF CURRENTS 78
EXERCISES 80

VIII.—THE TIDES.

CAUSE OF THE TIDES 81
SPRING AND NEAP TIDES 84

Page.
Height and Speed of the Tides 86
Exercises 87

IX.—THE ATMOSPHERE AND ITS CIRCULATION.

Composition, Moisture, etc. 89
Temperature and Pressure 92
Kinds of Winds 95
The Monsoons, etc. 99
Exercises 103

X.—CLIMATE AND ITS INFLUENCE.

Factors of Climate 105
Factors of Rainfall 109
Distribution of Rainfall 110
Types of Climate and Climatic Regions .. 111
Exercises 116

PART II.—ECONOMIC GEOGRAPHY.

XI.—VEGETATION, NATURAL AND CULTIVATED.

Vegetation Zones 118
Cultivated Vegetation 121
Exercises 127

XII.—ANIMALS AND MINERALS.

Distribution of Animal Life 128
Animal Products 131
Distribution of Minerals.. 132
Exercises 135

XIII.—OCCUPATIONS AND INDUSTRIES.

PAGE.
HUNTING, FISHING, AGRICULTURE, ETC. .. 137
MANUFACTURES 140
EXERCISES 143

XIV.—COMMERCE AND COMMUNICATIONS.

FACTORS OF COMMERCE 145
MEANS OF TRANSPORT 147
SEA-TRADE ROUTES 149
SHIP-CANALS 152
EXERCISES 154

XV.—NATURAL REGIONS OF THE WORLD.

CHIEF NATURE REGIONS 155
FACTORS OF ECONOMIC DEVELOPMENT 160
EXERCISES 163

PART III.—GENERAL GEOGRAPHY OF ASIA.

XVI.—PHYSICAL FEATURES, ETC.

POSITION, SIZE AND COASTS OF ASIA 165
PHYSICAL DIVISIONS 168
EXERCISES 173

XVII.—CLIMATE AND NATURAL REGIONS OF ASIA.

KINDS OF CLIMATE IN ASIA 174
DISTRIBUTION OF RAINFALL.. 176
NATURAL REGIONS OF ASIA 176
EXERCISES 181

XVIII.—RUSSIA IN ASIA.

Page.
The Russian Republics 183
Siberia 184
Russian Central Asia 187
Exercises 189

XIX.—THE MEDITERRANEAN REGION, OR LAND OF THE FIVE SEAS.

Recent changes 191
Transcaucasia 192
Turkey in Asia 193
Syria, Palestine, and Transjordan 195
Iraq, or Mesopotamia 197
Exercises 199

XX.—SOUTH-WESTERN TABLELANDS AND CENTRAL PLATEAUS.

Arabia 201
Persia 203
Afghanistan and Baluchistan 205
Tibet 207
Eastern Turkistan, Mongolia 208
Exercises 210

XXI.—MONSOON REGION—CHINA AND JAPAN.

China Proper 211
Manchuria 215
Japan and Korea 216
Exercises 221

XXII.—INDO-CHINA AND THE EAST INDIES.

Indo-China (Siam, Burma, etc.) 222

PAGE.
East Indies, or Malay Archipelago.. .. 226
Exercises 229

PART IV.—GENERAL GEOGRAPHY OF INDIA.

XXIII.—INDIA—PHYSICAL FEATURES, ETC.

Shape, Extent, and Coasts 278
Natural Regions 281
The Mountain Region of the North .. 235
Indo-Gangetic Plain 238
The Deccan Plateau 240
The Coast Strips 242
Exercises 243

XXIV.—INDIA—CLIMATE.

Factors of Indian Climate 244
The Monsoons 245
The Seasons in India 248
Distribution of Rainfall.. 249
Influences of the Climate 250
Exercises 251

XXV.—INDIA—IRRIGATION.

Methods of Irrigation 254
Distribution of Irrigation 555
Punjab Irrigation 566
Irrigation Projects 257
Exercises 263

XXVI.—INDIA—PRODUCTS AND INDUSTRIES..

Vegetable Products 652

ANIMAL PRODUCTS 271
MINERAL PRODUCTS 272
INDUSTRIES 273
EXERCISES 276

XXVII.—INDIA—COMMERCE AND COMMUNICATIONS.

EXPORTS AND IMPORTS 278
ROADS AND RAILWAYS 281
RAILWAY PROJECTS 284
AIR ROUTES 285
DISTRIBUTION OF POPULATION 285
RACES, LANGUAGES, ETC. 287
EXERCISES 288

XXVIII.—INDIA—POLITICAL DIVISIONS AND CHIEF TOWNS.

GOVERNMENT AND ADMINISTRATION OF INDIA .. 291
GOVERNMENT AND ADMINISTRATION OF THE PUNJAB 292
NATIVE STATES, ETC. 293
CHIEF TOWNS 294
THE FUTURE OF INDIA 302
EXERCISES 303

XXIX.—CEYLON AND OTHER ISLANDS IN THE INDIAN OCEAN.

CEYLON 304
MALDIVES, LACCADIVES, ETC. 307
EXERCISES 308

LIST OF ILLUSTRATIONS.

Figure. Page.
1. The Planets: Distances from the Sun .. 1
2. The Planets: Comparative Sizes .. 2
3. Proof of the Earth's Roundness .. 3
4. The Great Bear and the Pole Star .. 5
5. Zones of the Earth 6
6. What might have been 9
7. Effects of the Earth's Revolution .. 10
8. Direction of the Sun's Rays 13
9. Fixing Position on a plane 17
10. How to find Latitude 21
11. Time Zones of the World 25
12. The Date Line 29
13. The Mariner's Compass 30
14. Projection 33
15. Stereographic Projection 34
16. Orthographic Projection 35
17. Globular Projection 36
18. Cylindrical Projection 37
19. Mercator's Projection 38
20. Conical Projection 39
21. Hachures and Contours 41
22. Hachures and Contours 41
23. Phases of the Moon 45
24. Varying Time of Moon-rise 46
25. Solar Eclipse 47
26. Annular Eclipse of the Sun 47
27. Lunar Eclipse 48

PAGE.
28. FOLDING OF THE EARTH'S CRUST 55
29. ROCK FAULTS 56
30. RIFT-VALLEY 56
31. A VOLCANO 57
32. A SPRING 63
33. AN INTERMITTENT SPRING AND A WELL .. 63
34. AN ARTESIAN WELL 64
35. DELTA OF THE NILE 65
36. HOW TIDES ARE CAUSED 82
37. WHY TIME OF HIGH TIDE VARIES .. 83
38. SPRING TIDES 84
39. NEAP TIDES 85
40. RAIN-GAUGE 91
41. DISTRIBUTION OF PRESSURE AND PERMANENT WINDS 95
42. THE SOUTH-WEST MONSOON 99
43. THE NORTH-EAST MONSOON 100
44. CYCLONE 101
45. PATH OF CYCLONE 102
46. ANTI-CYCLONE 102
47. MAP OF INDIA SHOWING AIR ROUTES .. 287

LIST OF PLATES, ETC.

FACING PAGE
MID-NIGHT SUN IN SPITSBERGEN 14
A GEYSER 57
ARTESIAN WELL AT LUDHIANA 62
MAP OF THE WORLD: CURRENTS 74
MAP OF THE WORLD: ANNUAL RAINFALL .. 109
LAPLANDERS WITH REINDEER 130
MAP OF THE WORLD: SEA-TRADE ROUTES .. 149
ESKIMO AND HUT 160

FACING PAGE

MAP OF ASIA: PHYSICAL FEATURES 168
Do. SUMMER TEMPERATURE .. 173
Do. WINTER TEMPERATURE .. 174
Do. SUMMER PRESSURE 174
Do. WINTER PRESSURE 175
Do. SUMMER RAINFALL 175
Do. WINTER RAINFALL 176
PEOPLE OF THE TUNDRAS 177
MAP OF ASIA: POLITICAL (COLOURED) 183
MAP OF INDIA: PHYSICAL FEATURES 231
Do. SUMMER TEMPERATURE .. 244
Do. WINTER TEMPERATURE .. 245
Do. SUMMER PRESSURE 245
Do. WINTER PRESSURE 246
Do. SUMMER RAINFALL 248
Do. WINTER RAINFALL 249
MAP OF THE PUNJAB: CANALS 256
MAP OF INDIA: RAILWAYS 281
Do. DENSITY OF POPULATION .. 287
Do. POLITICAL (COLOURED) .. 291

PART I—PHYSIOGRAPHY.

CHAPTER I.

THE EARTH AND THE SEASONS.

The Position of the Earth in Space. The earth and a number of other heavenly bodies revolve round the sun as their centre. Arranged in order of their distance from the sun, they are (1) Mercury, (2) Venus, (3) Earth, (4) Mars, (5) Jupiter, (6) Saturn, (7) Uranus and (8) Neptune. Of these planets Jupiter is the largest and is 1,400 times the size of the earth. Mercury and Venus are both smaller than the earth. The former is the nearest to the sun, while the latter is the nearest to us and therefore appears to be the brightest of them all. It can easily be seen just after sunset or before sunrise, when it is known as the evening star or the morning star accordingly. (Figs. 1 and 2.)

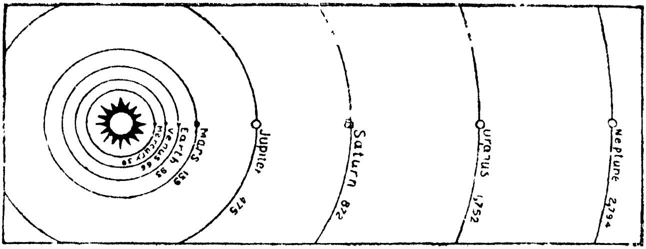


Fig. 1.—The Planets: Distances from the Sun shown in millions of miles.

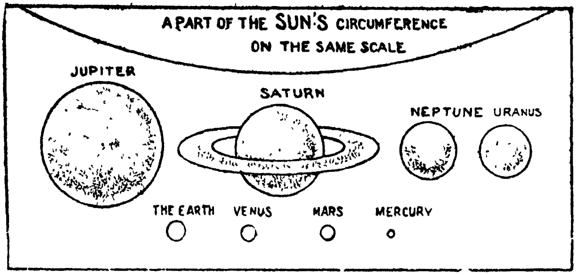


Fig. 2.—The Planets: Comparative Sizes.

The Shape of the Earth. The earth is round like a ball, slightly flattened towards two opposite points. In scientific language it is called an oblate spheroid, *i.e.*, a flattened sphere. It appears to be flat, because only a small part of it can be seen at one time. That it is actually round is proved by the following facts:—

(1) If we travel northward or southward from any place, the position and path of the stars are altered; new stars come into view as we proceed, while others disappear behind us. This can happen only on a sphere.

(2) The sun rises earlier for places to the east, and later for places to the west. (Compare the time of sunrise for Calcutta, Delhi, and Peshawar on any date.) Had the earth been flat, the sun would have been visible at the same time at all places.

(3) When a ship is sailing towards the land we see the top sails first, next the masts, and last of all the hull or body of the ship. The lower portions are at first hidden from view by the curved surface of the sea. If the earth were flat, we should see the hull first, because it is the largest. This proof was first given by Strabo,

a Greek geographer. (Fig. 3.)

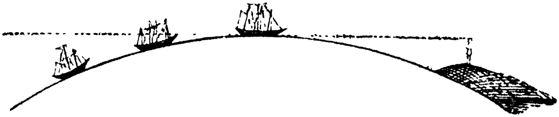


Fig. 3.—Proof of the Earth's Roundness.

(4) If we are on a height or on the surface of the ocean, we see a line all round where the earth and the sky seem to meet; this line is always and everywhere circular in shape. This can happen only on a sphere.

(5) Ships continuing to sail east or west come at last to the place from which they started, just as an ant might crawl round an orange. If this happens in whatever direction we travel, the earth must be a round body.

(6) In a lunar eclipse, which is caused by the shadow of the earth falling on the surface of the moon, the shadow always ends in an arc of a circle Only a sphere can in all positions throw a circular shadow. This proof was first given by Aristotle, the tutor of Alexander the Great.

Though the above facts clearly show that the earth is round in shape, yet the great irregularities of its surface, such as high mountains and deep valleys, appear at first sight to show that it is not so. But this impression is removed when we consider the proportion of these irregularities to the size of the earth. The highest mountain, Mount Everest, rises to a height of 29,000 feet above the level of the sea, or less than five and a half miles. But this height is only about 1/1450 of the earth's diameter and 1/4500 of its circumference. It would be represented on an artificial globe of the ordinary size by the smallest visible grain of sand. Similarly the slightest scratch of a fine pin would proportionately represent the deepest place on the earth Thus it is quite clear that the irregularities of the surface of the earth are quite insignificant and have no importance in relation to its magnitude.

The Earth's Oblateness. This is proved by the fact that a body weighed by a spring balance weighs least at the equator, and its weight increases slightly as the poles are approached; it is heaviest at the poles. As weight depends on the force of gravity, which decreases with distance from the centre of the earth, a body at the poles must be nearer this centre than is a body at the equator.

The Size of the Earth. The diameter of the earth from east to west is about 8,000 miles and from north to south is about 26 miles less, because the earth is flattered or compressed towards two opposite points. Its circumference is about 25,000 miles. The area of its surface is about two hundred million square miles.

The size of the earth was first determined by Eratosthenes in Egypt as early as 250 B.C.

Some Important Terms. Before we proceed with the motions of the earth, it is necessary to define the following terms.—

Axis. The imaginary line drawn through the centre of the earth and on which it turns is called its *Axis*.

Poles. The ends of the axis, that is, the points where it cuts the earth's surface, are called the *Poles*. The northern end is called the North Pole, and the southern end is called the South Pole. This axis, when produced indefinitely both ways, pierces the sky at two points. These are called the North and South *Poles of the Heavens*. They are also called the *Celestial Poles,* as distinguished from terrestrial poles of the earth.

Pole Star. The north pole of the heavens is very near a certain star which is therefore called the *North*

Star or *Pole Star* All the stars appear to revolve once a day in circles round it.

How to find the Pole Star. On a clear night if you look at the heavens, you will find a group of seven stars known as the *Great Bear* (called *Sapt Rishi* in the vernacular). Five of these stars make a sort of semi-circle. The remaining two are known as *Pointers.* If a line be drawn through these two pointers and produced to the north, it will pass through a bright star. This star is called the *Pole Star* (in India *Dhruva Tara* or *Qutb*). It always directs us to the north and is visible only in the northern hemisphere. (Fig. 4.)

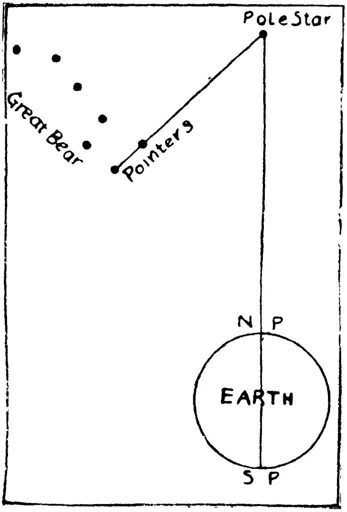


Fig. 4. Position of the Pole Star.

Equator. The imaginary line drawn round the earth midway between the poles is called the *Equator.* The axis of the earth cuts the plane of the equator at right angles. The equator divides the surface of the earth into two equal parts, each of which is called a *Hemisphere.*

Altitude of the Sun. This is the height of the sun from the earth measured in degrees.

Plane. A *Plane* is a perfectly flat area. As a line is defined as length without breadth, so a plane is length and breadth without thickness or elevations.

Orbit. The *Orbit* is the path of the earth or other planet round the sun.

Plane of the Orbit. This is the plane in which this orbit lies.

Ecliptic. This is the *Great Circle* of the heavens round which the sun seems to travel in the course of a year.

Zenith. This is the point in the heavens which is exactly over our heads.

Nadir. This is the point in the heavens which is directly under our feet.

Antipodes. The opposite side of the earth to us is called our *Antipodes* (Greek *anti*, opposite; *podes*, feet). It is so called because people walking on the earth at that point have their feet turned towards ours.

Horizon. This is the *great circle* round us where the earth and the sky seem to meet. The higher we stand, the greater the horizon becomes.

Tropic of Cancer is an imaginary line drawn round the earth 23½° north of the equator.

Tropic of Capricorn is an imaginary line drawn round the earth 23½° south of the equator.

Arctic Circle is an imaginary line drawn round the earth 23½° south of the north pole.

Antarctic Circle is an imaginary line drawn round the earth 23½° north of the south pole.

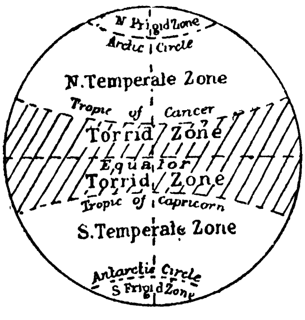


Fig. 5.—Zones of the Earth.

Zones of the Earth. The areas of the earth bounded by these four circles are called Zones or Belts, and are named from the general nature of their climate. The belt between the tropics is called the *Torrid Zone,* as it is the hottest as a whole. The areas round the poles are called the *North and South Frigid Zones,* as they are the coldest. The intermediate areas are called the *North and South Temperate Zones.* (Fig. 5.)

The Motions of the Earth. The earth has two motions, Rotation and Revolution. Let us consider them in detail.

1. **The Rotation of the Earth.** We daily see that the sun rises in the east, passes over our heads, and sinks in the west, to re-appear next morning. Thus at first sight it appears that it is the sun which is moving round the earth. But it is not so. Just as when we are sitting in a fast train the objects outside seem to run in the opposite direction to that in which the train is moving, in the same way the sun appears to move from east to west on account of the turning of the earth on its axis from west to east in 24 hours. This daily turning of the earth on its axis is called the *Rotation of the Earth.*

The Effects of the Earth's Rotation (*a*). *Day and Night.* If you bring an india rubber ball before a burning lamp, you will observe that in whatever position you place it, half of it is always in light, and the other half in darkness. This is because the ball is opaque, that is, light cannot pass through it. If you rotate the ball, you will observe that not only is half of it in light and the other half in darkness, but that each part of it successively comes into the light, remains there for a while, and then passes into darkness. The earth, like the ball, is opaque and exactly in the same way rotates on its axis from west to east in front of the sun. The part of the earth which is towards the sun is in the light and has its day, while the part away from it is in darkness and has its night. Thus *day* and *night* are caused by the earth's rotation.

(*b*) As shown above, rotation produces the apparent revolutions of the sun and stars round the earth.

(*c*) As we shall see later, rotation is one of the causes of the tides of the ocean and affects ocean currents.

2. **The Revolution of the Earth.** Just as there is an apparent *daily* motion of the sun, so there is an apparent *yearly* motion of the sun. On 21st March and 23rd September it rises exactly in the east and sets in the west; but from 22nd March to 22nd September it rises a little north of east and sets a little north of west; and from 24th September to 20th March it rises a little south of east and sets a little south of west. Again, the altitude of the sun at noon is not the same throughout the year. On 21st June it is the highest and on 22nd December it is the lowest. These yearly changes in the position of the sun are not due to any motion of the sun itself, but are due to the revolution of the earth round the sun in 365 days, with its axis inclined to the plane of its orbit at an angle of 66½ degrees and always pointing in the same direction.

Thus the earth has two motions *simultaneously*: (1) the rotation on its axis in 24 hours, and (2) the revolution round the sun in 365 days.

The Effects of the Earth's Revolution. We have just said that the axis of the earth makes an angle of 66½ degrees with the plane of its orbit. Suppose for a minute it is at right angles to the plane of its orbit as shown in Fig. 6. What do we find? We find that NS, that is, the line which divides the light half from the dark half, coincides with the axis; LM is equal to MP; QO is equal to OR; CD is equal to DE. Thus L (Lahore) in the northern hemisphere, Q (Quito) on the equator, and C

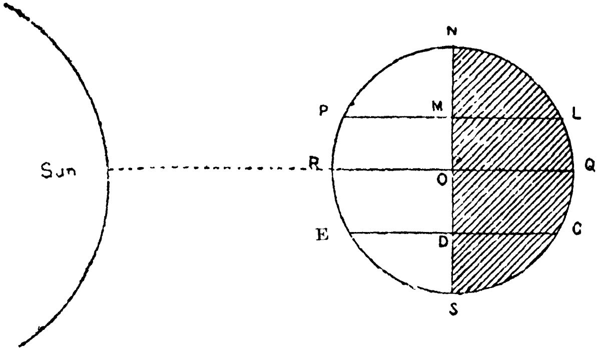


Fig. 6—What might have been.

(Cape Town) in the southern hemisphere, remain half the time in light and half the time in darkness In this position, therefore, as the earth rotates and revolves, days and nights are equal all over the surface of the earth. The sun always rises due east, sets due west, and remains at noon at a particular place at the same height throughout the year: consequently there is no change of seasons. But these facts go against our actual experience. Therefore the axis of the earth cannot be perpendicular to the plane of its orbit.

Now look at Fig. 7 in which the axis of the earth is shown as inclined at an angle of 66½ degrees to the plane of its orbit, no matter what the position of the earth with respect to the sun may be.

Position I. When the earth is in position I, *i.e.*, on 21st June, we observe the following:

(1) The north pole is inclined 23½ degrees towards the sun while the south pole is 23½ degrees away from it. (2) The rays of the sun not only reach the north

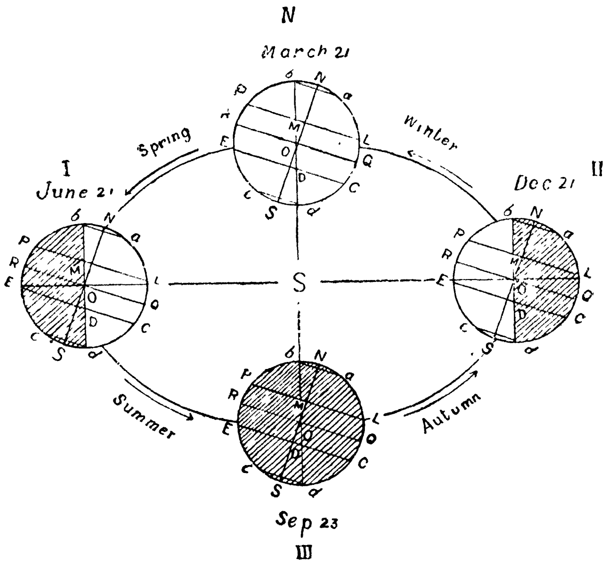


Fig 7.—Effects of the Earth's Revolution

pole but also shine for $23\frac{1}{2}$ degrees beyond it, while they fall short of the south pole by the same distance. (3) The sun is vertical over the Tropic of Cancer, *i.e.* at all places $23\frac{1}{2}$ degrees north of the equator. (4) Although the earth rotates on its axis the area from *a* to *b* round the north pole remains in light, while the corresponding area from *c* to *d* round the south pole is in continuous darkness. (5) Any place L (Lahore) in the northern hemisphere will remain in the light for more than half the time of rotation (LM>MP), *i.e.*, it has longer days and shorter nights. (6) Any place Q (Quito) on the equator remains for half the time in light and half the time in darkness (QO=OR), *i.e.*, it has days and nights equal. (7) Any place C (Cape Town) in the southern hemisphere remains longer in darkness than in light (CD<DE), *i.e.*, it has longer nights and shorter days. (8) It is summer for the northern hemisphere and winter for the southern hemisphere. This position of the earth is called the *Summer Solstice* (Latin *sol*, sun; *stare*, to stand), because the sun seems to stop or pause before returning

Position II. When the earth has made half its revolution and come to position II, *i.e.*, on 21st December, the conditions are reversed. (1) The south pole is inclined 23½ degrees towards the sun, while the north pole is 23½ degrees away from it. (2) The rays of the sun not only reach the south pole, but also fall for 23½ degrees beyond it, while they fall short of the north pole by the same distance. (3) The rays of the sun fall perpendicularly on the Tropic of Capricorn, *i.e.*, at all places 23½ degrees south of the equator. (4) The area round the south pole remains in continuous light, while the area round the north pole is in continuous darkness. (5) Places in the northern hemisphere have shorter days and longer nights. (6) Places on the equator have days and nights equal. (7) Places in the southern hemisphere have longer days and shorter nights. (8) It is summer for the southern hemisphere and winter for the northern hemisphere. This position of the earth is called the *Winter Solstice*.

Positions III and IV. When the earth is in positions III and IV, *i.e.*, on 23rd September and 21st March respectively, we find the following: (1) The circle of light passes through the poles. (2) The rays of the sun at noon fall perpendicularly on the equator. (3) Days and nights are of equal duration everywhere. (4) When the earth is at III, it is spring for the southern hemisphere and autumn for the northern hemisphere. This position of the earth is called the *Autumnal Equinox* (Latin *aequus*, equal; *nox*, night). (5) When the earth is at IV, it is spring for the northern hemisphere and autumn for the southern hemisphere. This position of the earth is called the *Vernal* or *Spring Equinox.*

Conclusion. From the above explanation we see that, as the earth revolves round the sun in 365 days with its axis inclined 66½ degrees to the plane of its orbit and always pointing in the same direction, the duration of day and night regularly increases and decreases and the altitude of the midday sun regularly changes. Therefore the amount of heat received from the sun varies during the course of the year, and thus we get a cycle of seasons. From all that has been said above we can now briefly state the effects of the earth's revolution and inclination of its axis:

(*a*) Varying length of day and night.
(*b*) Varying altitude of the sun at noon.
(*c*) The changes of the seasons which are the result of (*a*) and (*b*).
(*d*) The apparent movements of the sun and planets among the fixed stars.

Factors upon which the amount of heat received from the sun depends. The amount of heat received from the sun at any place on the earth's surface depends mainly upon two things, the length of the day and the altitude of the sun:—

(*i*) The *time* during which the place is exposed to the sun. In summer the days are longer than the nights; therefore the earth receives more heat during the day-time than it can receive during the night.

(*ii*) The *direction* of the rays falling on the place. The vertical rays are much hotter than the oblique rays for two reasons: (*a*) The vertical rays have to pass through less atmosphere than the oblique rays and thus lose less of their heat than do the slanting rays. (*b*) The vertical rays are spread over less area than the oblique rays and thus produce greater heat than the slanting rays. (Fig. 8.)

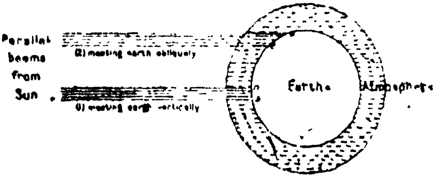


Fig 8.—Direction of the Sun's Rays.

At noon the rays of the sun are more nearly vertical than during the morning and the evening. Therefore the mornings and evenings of a place are less warm than the noon.

Similarly, in summer the rays are more nearly vertical than in the winter. Therefore the summers are hotter than the winters.

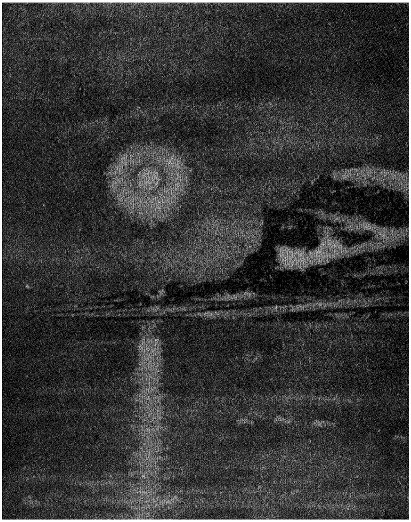
The *distance* of the sun from the earth at different times has little effect upon the amount of heat received. The earth, as you know, revolves round the sun, not in a circle, but in an ellipse (see Fig. 7). Therefore the earth is sometimes nearer to the sun than it is at other times. The minimum distance in December is 91,250,000 miles, and the maximum in June is 94,500,000 miles. But this difference of distance is comparatively so small that the greater distance from the sun does not lessen the heat to any perceptible degree.

When the earth is nearest to the sun it is said to be in *Perihelion* (Greek *peri,* near; *helios,* sun). When it is farthest away from the sun it is said to be in *Aphelion*

(Greek *apo*, away; *helios*, sun).

July hotter than June and Afternoon hotter than Noon. The northern hemisphere receives the greatest amount of heat on 21st June, because that day is the longest and the altitude of the sun is the greatest. But the highest average temperature takes place at some time *after* that date. Similarly on 21st December the day is the shortest and the altitude of the sun is the smallest, therefore the amount of heat received is the least. But the lowest average temperature takes place *after* that date. What is the reason? The reason is that the northern hemisphere is *gaining* (receiving more than it radiates) heat most rapidly after 21st June, and it continues to gain heat, though to a less extent, for some time afterwards. Similarly, the northern hemisphere is losing heat most rapidly on 21st December, and this continues to a less extent for some time afterwards. In a corresponding way, the hottest time on a summer day is not noon, but the afternoon; and the coldest time in the winter is not midnight, but after midnight.

Midnight Sun. Look at Fig. 7 and observe that as the earth revolves round the sun from position I to position II, the area from *a* to *b* round the north pole begins gradually to pass out of the light; while the corresponding area from *c* to *d* round the south pole comes gradually into the light. So the north pole remains in light and the south pole in darkness for half the time of the revolution of the earth. In other words, days and nights are of six months' duration at the poles and of 24 hours duration at the Arctic and Antarotic Circles. As at places situated within the Arctic and Antarctic Circles there is a day of 24 hours' duration or more, the sun will be seen at midnight. This sun is called the Midnight Sun.



The Midnight Sun in Spitsbergen.

Twilight. When the sun is rising or setting, that is, when it is a little below the horizon, the upper layers of the atmosphere are exposed to direct sunlight, which is there reflected and dispersed by the dust and water particles contained in the air. This diffused light reaches the earth and is called *Twilight* (literally "two lights," those of the day and the night). Had there been no atmosphere round the earth there would have been no twilight. Sunset would then have been like the putting out of a lamp in a dark room. There would have been neither dusk nor dawn.

Exercises.

1. What heavenly bodies revolve round the sun as their centre? How would you distinguish Venus from the other planets?

2. What is the shape of the earth? Why does it appear to be flat?

3. How can you prove that the earth is round like a ball? Why do not mountains and valleys affect its roundness?

4. Distinguish the celestial poles from the terrestrial poles. How would you find the Pole Star on a clear night?

5. What are the motions of the earth? What effects do they produce?

6. How will you prove that the earth rotates on its axis? (Hint: from the apparent daily motion of the sun.)

7. What proof have you that the earth revolves?

8. Explain clearly how days and nights are caused. Why do they increase and decrease in length?

9. Where and when are the days and nights equal

throughout the year? Why are they not so everywhere? Give a full explanation.

10. What is the change of seasons due to? What part does the inclination of the earth's axis play in their regular succession?

11. Give reasons for the following:—

(*a*) Mornings and evenings are less warm than noon.

(*b*) Noon is less warm than afternoon.

(*c*) Summer is hotter than winter.

(*d*) July is hotter than June.

12. Explain the term Midnight Sun. Name the places where the midnight sun can be seen.

13. What is twilight and how does it take place?

14. Explain the following terms:—

Altitude of the sun; tropics; solstice; equinox; perihelion; nadir; antarctic; antipodes.

CHAPTER II.

LATITUDE AND LONGITUDE.

How to determine the Position of a Place on a Plane or Flat Area. In Fig. 9 ABCD is a field, in which X is a tree. The position of the tree is to be determined. Through X draw XR perpendicular to BC. Measure XR; say it is 4 yards. But this is not sufficient to enable us to locate the tree exactly, for there can be several trees 4 yards from the line BC. Now draw XP perpendicular to AB. Measure it; say it is 5 yards. Now there is only one tree that is 4 yards from the southern boundary of the field and 5 yards from the western

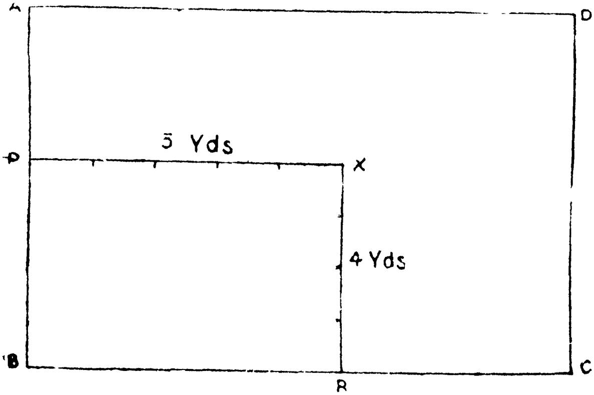


Fig 9.—Fixing position on a plane.

boundary. Thus in order to fix the position of a place on a flat area, it is necessary to know its perpendicular distance from two fixed lines. The fixed lines (AB and BC in this case) are called the *Axes of Reference* and the point where they intersect (B in this case) is called the *Point of Origin.*

How to Locate a Place on a Sphere. To fix the position of a place on a sphere, two similar fixed lines or axes of reference, from which its distance may be measured, are necessary. One such fixed line is the Equator (see previous definition). The other fixed line is one of the Meridians. What is a *Meridian?* A *Meridian* (Latin *meridies,* mid-day) is a semi-circle drawn from the north pole to the south pole, cutting the equator at right angles. It is so called because all places situated on it have their midday or noon at the same time. There are 360 meridians, but there is required one fixed or *Prime Meridian* to measure from. Various nations have different prime meridians. The meridian which passes through the Royal Observatory at Greenwich is the prime meridian for the English and most other nations. The French for the same purpose use the meridian which passes through Paris as their prime meridian.

Now distance can be measured north or south of the equator and east or west of the prime meridian. The point where the equator and the prime meridian intersect will be the point of origin on the sphere. (Take an india-rubber ball and mark on it the equator and the meridians.) But remember that distance on a sphere is not measured in miles, yards, and feet, but in degrees. minutes, and seconds. It is therefore called the *Angular Distance.*

Angular Distance. The circumference of a circle may be divided into 360 equal intervals or parts, whether the circle is great or small. The angle which one of these parts subtends at the centre of the circle is called a degree (written °), or 1/90 of a right-angle. Each degree may be divided into 60 minutes (written ′), and each minute into 60 seconds (written ″). The distance on the circumference of a circle measured in degrees, minutes, and seconds is called the *Angular Distance.*

Latitude. The angular distance of any place north or south of the equator is called the *Latitude* of that place.

Circles drawn round the globe parallel to the equator are called *Parallels* of *Latitude.* At intervals of one degree there are 180 such circles, 90 north and 90 south of the equator.

Longitude. The angular distance of any place east or west of the Prime Meridian is called the *Longitude* of that place. The 360 meridians or half-circles are called *Lines of Longitude.* Thus we know the position of any place on the earth when we know its latitude and longitude.

Latitude is measured—
——in degrees up to 90° north or south,
——along the meridian of the place;
——from the equator;
——to the parallel of latitude of the place.
Longitude is measured—
——in degrees up to 180° east or west;
——along the parallel of latitude of the place *or* along the equator;
——from the meridian of Greenwich;
——to the meridian of the place.

Value of a Degree of Longitude and of Latitude in Miles. All the lines or circles of longitude are of the same size, as each of them goes through the poles and runs right round the earth. Each is therefore called a *Great Circle*, because it is the largest circle that can be drawn round the earth and each meridian is half of a great circle. As all of these circles converge towards the poles, and are farthest apart at the equator, the distance covered by one degree of longitude grows less and less as we proceed from the equator to the poles. From this we see that the value of a degree of longitude varies according to the latitude. At the equator it will be 1/360th of the earth's circumference (which we know is about 24,900 miles) and is therefore equal to about 69 miles. At the poles, since all the meridians meet there, a degree of longitude is zero and has no length. At the intervening degrees of latitude its length will be as follows:—

At 10° it is about 60 miles.
At 20° ,, ,, 65 ,,
At 30° ,, ,, 60 ,,
At 40° ,, ,, 53 ,,
At 50° ,, ,, 45 ,,
At 60° ,, ,, 35 ,,
At 70° ,, ,, 24 ,,
At 80° ,, ,, 12 ,,
At 90° ,, ,, 9 ,,

On the other hand, each of the parallels of latitude is clearly at one uniform distance from the equator and from any other parallel of latitude. If the earth were a perfect sphere, a degree of latitude would therefore be everywhere of the same length. But owing to the flattening near the poles a degree of latitude is slightly longer there. We may, however, disregard this small difference, and take the length of a degree of latitude as 69 miles approximately. It should be remembered that while all circles of longitude are of the same size, the parallels of latitude become smaller as we approach the poles. All parallels of latitude (except the equator) are *Small Circles;* the equator is a Great Circle.

How to Find the Latitude of a Place.

(*i*) In figure 10 let ADBE be the earth, AB the

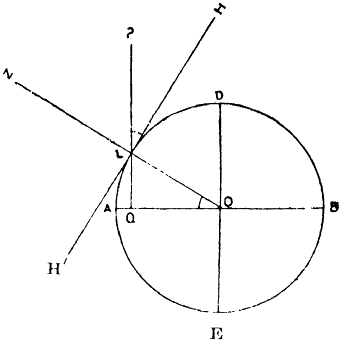


Fig. 10.—How to find Latitude.

equator, DE the axis and DAE the meridian of the place L situated on it. Join OL and produce it to Z. Z is then the zenith of L. Draw HH′ perpendicular to ZL. Then HH′ is the horizon of L. Through L draw PQ parallel to DO, which is the direction of the celestial pole or pole star. Thus the altitude of the pole star is <PLH and the latitude of L is <LOA. As PQ is parallel to the perpendicular DO, therefore △QLO is a right-angled triangle. Thus angle PLH *plus* angle ZLP is equal to angle LOQ *plus* angle QLO. But angle QLO is equal to vertical angle ZLP; therefore angle PLH is equal to angle LOQ. Thus we see that the altitude of the Pole Star is equal to the latitude of the place.

This we can also see in another way. The height of the Pole Star is 90 degrees at the north pole and the north pole is 90 degrees from the equator. Therefore at the equator the height of the Pole Star is 0°. At 1 degree north the height of the Pole Star will be 1 degree, and so on. Suppose the height of the Pole Star at Lahore is 31½ degrees; the latitude of Lahore will consequently be 31½ degrees.

The altitude of the pole star is exactly found by means of an instrument called a Sextant. Remember that this method of finding latitude is applicable only to places situated in the northern hemisphere, as the Pole Star is visible only in the northern hemisphere.

(*ii*) On 21st March and 23rd September the midday sun is vertical at the equator. Its height at the poles will be 0°. Hence the latitude of any place on these dates will be equal to 90 degrees *minus* the altitude of the midday sun of that place, which can be determined by the sextant. Suppose the height of the midday sun at Lahore on 21st March or 23rd September is 58½ degrees, the latitude of Lahore is 90 degrees *minus* 58½ degrees, or 31½ degrees.

Local Time. The circumference of the earth is divided into 360 parts or degrees. As it goes round on its axis once in 24 hours, its surface moves at the rate of 15 degrees an hour, or 1 degree in 4 minutes. As it rotates from west to east, the sun rises earlier for places to the east and later for places to the west. Suppose it is noon at Greenwich, it will be afternoon at places situated to the east of Greenwich, and forenoon at places west of Greenwich. Therefore when it is noon at Greenwich it will be 12-4 P.M. (*post meridiem*=afternoon) at Canterbury, situated 1 degree east of Greenwich, and 11-56 A.M. (*ante meridiem*=before noon) at Reading, situated 1 degree west of Greenwich; 6 P.M. at Dacca, situated 90 degrees east of Greenwich, and 6 A.M. at New Orleans, situated 90 degrees west of Greenwich.

Rule to Find Local Time. From the above explanation we deduce the following rule for finding the local time of a place when the longitude of the place is given:—

For places *east* of Greenwich add four minutes to the Greenwich time for every degree of longitude.

For places *west* of Greenwich subtract four minutes from the Greenwich time for every degree of longitude.

Examples:—

(1) What is the time at Madras, 80 degrees east longitude, when it is noon at Greenwich?

For one degree of longitude there is a difference of 4 minutes; for 80 degrees there is a difference of 80×4 minutes=320 minutes, or 5 hours and 20 minutes. As Madras is situated to the east of Greenwich 5 hours and 20 minutes should be added to the Greenwich time. Therefore the time at Madras will be 5-20 P.M.

(2) Find the time at Quito, 78 degrees W, when it is noon at Greenwich.

For one degree of longitude there is a difference of 4 minutes; for 78 degrees there is a difference of 78×4 or 312 minutes, or 5 hours and 12 minutes.

As Quito is situated to the west of Greenwich 5 hours and 12 minutes should be subtracted from the Greenwich time. Therefore the time at Quito will be 6-48 A.M.

(3) What is the time at Peshawar, 71 degrees E., when it is 1 P.M. at Tokyo, 139 degrees E.; and *vice versa?*

The difference of degrees of longitude between Peshawar and Tokyo is equal to 139°—71°=68 degrees.

For one degree there is a difference of 4 minutes; for 68 degrees there is a difference of 68×4=272 minutes, or 4 hours and 32 minutes.

As Peshawar is situated to the west of Tokyo 4 hours and 32 minutes should be subtracted from Tokyo time. Therefore the time at Peshawar will be 13—(4-32)

=8-28 A.M.

Again, as Tokyo is to the east of Peshawar, the time at Tokyo will be 1+(4-32)=5-32 P.M. when it is 1 P.M. at Peshawar.

(4) Find the time at New York, 74 degrees W. when it is Thursday 2 A.M. at San Francisco, 122 degrees W; and *vice versa.*

The difference of degrees of longitude between New York and San Francisco is equal to 122°—74°=48 degrees.

For one degree there is a difference of 4 minutes; for 48 degrees there is a difference of 48×4 or 192 minutes, or 3 hours and 12 minutes. As New York is situated to the east of San Francisco 3 hours and 12 minutes should be added to the San Francisco time. Therefore the time at New York will be Thursday 5-12 A.M.

Again, as San Francisco is to the west of New York the time at San Francisco will be 14—(3-12)=10-48 P.M. Wednesday, when it is Thursday, 2 A.M. at New York.

(5) What will be the time at Lahore, 74 degrees E., when it is Monday 6-15 P.M. at Chicago, 87 degrees W.; and *vice versa?*

The difference of degrees of longitude between Lahore and Chicago is equal to 74°+87°=161 degrees. For one degree there is a difference of 4 minutes; for 161 degrees there is a difference of 161×4, or 644 minutes, or 10 hours and 44 minutes.

As Lahore is situated to the east of Chicago 10 hours and 44 minutes should be added to the Chicago time. Therefore the time at Lahore will be (6-15)+(10-44)=16 hours and 59 minutes=4-59 A.M. Tuesday.

Again, when it is 6-15 P.M. on Monday at Lahore the time at Chicago will be 18-15 *minus* 10-44, or 7-31 A.M. Monday.

Standard Time. As the local time at each place is different, it would be very inconvenient if every town were to keep its own local time. To avoid this inconvenience, the local time of one important place is adopted throughout a large area. This time is known as the *Standard Time*. The whole of Great Britain takes its standard time from Greenwich. Ireland takes its time from Dublin, which is 25 minutes behind the English time. In vast countries it has been found convenient to fix Time Zones or belts, all places in each zone keeping

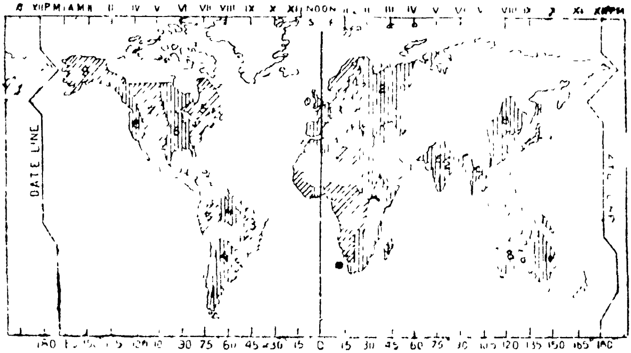


Fig. 11.—Map of the World showing Time Zones.

the same time. As each zone is 15 degrees wide, its time is exactly one hour ahead of its western and one hour behind its eastern neighbour. Thus in Canada there are five Time Zones, called Atlantic, Eastern, Central, Mountain, and Pacific, whose times are respectively four, five, six, seven, and eight hours behind Greenwich time. Similar arrangements exist in the United States and in Australia. In fact, in nearly all civilised countries the standard time now adopted is either Greenwich time or differs from it by an exact number of hours or half-hours.

Indian Standard Time. Formerly the Indian standard time was the Madras local time, which was 5 hours 21 minutes and 10 seconds in advance of Greenwich time. But as this standard time did not bear a simple and easily remembered relation to Greenwich time, it has been changed since 1st January 1906 from Madras time to that of a place lying on $82\frac{1}{2}°$ E longitude, so as to make the Indian standard time exactly $5\frac{1}{2}$ hours ahead of Greenwich time. This place roughly corresponds with Allahabad whose local time is 5 hours and 28 minutes, or only two minutes short of the standard time. On the 1st January 1906 all the railway and telegraph clocks were put at Standard Indian Time. Calcutta retains its former Calcutta Time, which is twentyfour minutes in advance of the Standard Time. But in Bombay the local time is retained only on the clocks that are maintained by the Municipality and in the establishments of orthodox Hindus. Elsewhere Standard Time is universal.

How to Find the Longitude of a Place. Just as we can find the local time of a place when its longitude and the Greenwich time are given, we can by the inverse process find the longitude of the place when the local time and the Greenwich time are known. The local time of a place can be found by observing when the sun reaches its greatest altitude there, and the Greenwich time can be obtained by carrying a chronometer set to Greenwich time.

Examples:

(1) What is the longitude of a place when it is 5 P.M. at Greenwich and noon at that place?

The difference of time between the two places is equal to 5 hours or 5×60 or 300 minutes.

For 4 minutes there is a difference of 1 degree of ongitude; for 300 minutes there is a difference of 300/4 or 75 degrees of longitude.

As the Greenwich time is ahead of the local time, the place is situated to the west of Greenwich. Result: 75° W.

(2) Find the longitude of a place when the local noon occurs at 8-40 A.M. by Greenwich time.

The difference of time is equal to 12—(8-40) or 3 hours 20 minutes, or 3×60+20=200 minutes. For 4 minutes there is a difference of 1 degree; for 200 minutes there is a difference of 200/4 or 50 degrees.

As the Greenwich time is behind the local time, the place is situated 50 degrees E. of Greenwich. Result: 50° E.

Time and Circumnavigation of the Globe. We have just seen that the local time of places according to their position east or west of Greenwich is 4 minutes before or behind Greenwich time for every degree of longitude. Now, if a man travelled eastward round the world and adjusted his watch to the local time, he would set the hands of his watch 4 minutes *forward* for every line of longitude that he passed, or 1 hour forward for every 15 degrees of longitude, or 24 hours forward for 360 degrees of longitude. Therefore the number of days that he had apparently spent in travelling would be less by 24 hours or one day than the number of days he had actually spent. Thus he would appear to have *gained* a day. Conversely, if he travelled westward, he would put his watch altogether 24 hours behind Greenwich time, and thus would appear to have *lost* a day.

On the earliest voyages round the globe this change of time was not taken into consideration and consequently several strange things happened. When Captain Basil

Hall reached Manila (120° E.) he found that the people's Sunday was his Monday. The reason was that he had travelled eastward and gained a day. Similarly, when Sir Francis Drake returned to England after a world-voyage he thought that the day was Saturday, whereas it was Sunday. The reason was that he had travelled westward and lost a day. Again, at Sitka (135° W.), the old capital of Alaska, half the people are Russians who have come from Russia across Asia and half are Americans from the United States. Hence, when it is Sunday with the Russians it is Saturday with the Americans, and the Russians are busy on Monday at the very time when the Americans are observing their Sunday.

Date Line. Suppose we travel from Greenwich eastward to a place A on longitude 180 degrees E. We shall find the local time there 12 hours ahead of Greenwich time. So that when it is 6 A.M. on Wednesday April 18th, at Greenwich, it will be 6 P.M. on Wednesday April 18th, at A. Similarly the local time at place B on longitude 180 degrees W. will be 12 hours behind that of Greenwich, so that when the time at Greenwich is 6 A.M. on Wednesday April 18th, at B it will be 6 P.M. on Tuesday April 17th. Thus two places in longitude 180 degrees E. or 180 degrees W. agree as regards the time of day, but differ by one day as regards the date. But these two places are in reality one and the same, for if we count from the east the place will be 180 degrees E., and if we count from the west it will be 180 degrees W.

To avoid this confusion of dates, ships, when they cross the 180° meridian, add or deduct a day according as they are sailing towards the east or towards the west. This line where they change the date is called the *Date*

Line.

Remember that this line does not exactly follow the line of 180° longitude. The reason is that 180° longitude passes through groups of islands in the Pacific Ocean. Had the date line followed 180° longitude, it would have caused a difference in date between two neighbouring islands under the same administration. To avoid this confusion of date the line has a zigzag course as shown in Fig. 12.

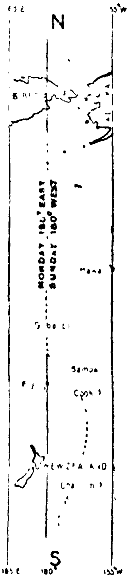


Fig 12.—The Date Line.

Compass. The Compass is an instrument used by seamen, surveyors, and travellers, to indicate direction. The mariner's compass consists of three parts, namely, the box, the card, and the needle. The needle, which is the essential part, is a small bar of magnetized steel. It is balanced on a pin in the box in such a way that it remains level in all positions of the ship. Being magnetized, the needle always points towards the north. The circular card is divided into 32 equal parts by lines drawn from the centre to the circumference; these are called *Points*. The intervals between the points are further divided, so that the whole circumference is finally divided equally into 360 degrees. The four principal points are called the *Cardinal Points*: *viz.*, North, South, East, and West. The names of the rest are compounded of these, as N.E., S.E., S.W., N.W., N.N.E., N.N.W., N. E. by E. and so on. (See Fig. 13).

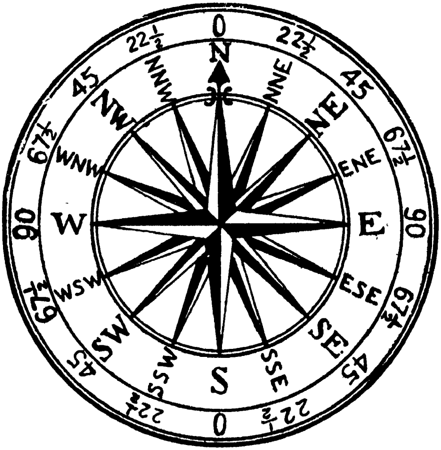


Fig 13 —The Compass.

Exercises.

1. What is a longitude? Distinguish it from a line of longitude. Why does it decrease in length as it gets farther from the equator?

2. What is a latitude? How would you determine the latitude of a place from the pole star?

3. What purpose do latitude and longitude serve? How would you determine the latitude of your town on 21st March?

4. The latitude of Calcutta is 22½ degrees N.; its longitude is 88½ degrees E. Find the latitude and longitude of its antipodes.

5. Explain the terms "local time" and "standard

time." Why is the former not much used in everyday life?

6. Find the time at Lahore and at Bombay when it is 5 A.M. at Paris.

7. When it is 11-30 P.M. at Peshawar, what time will it be at New York and at London?

8. How is the longitude of a place determined when the local and Greenwich times are known?

9. Find the longitude of a place when local noon occurs at 2-40 P.M. by Greenwich time.

10. What is the longitude of a place when the local time and the Greenwich time are 2-55 A.M. and 4-40 P.M., respectively?

11. Explain the following terms:—

Date Line, Great Circle, Prime Meridian and Compass.

12. When should a signaller wire from London to Melbourne (145° E.) and to Quebec (70° W.), so that the messages may be received in both places at 6 A.M.. the period of transit to each place being only 30 seconds [P. U. 1904].

13. Calculate to the nearest degree the longitudes of Melbourne and Buenos Ayres, which are respectively 9 hours, 39 minutes and 35 seconds fast and 3 hours 53 minutes and 29 seconds slow by Greenwich [P. U. 1898].

14. What will be the difference in the times of two places which are 35½ degrees east or west of each other?

15. Explain fully why a day appears to be lost in sailing round the earth from east to west and gained when sailing from west to east [P. U. 1914].

CHAPTER III.

REPRESENTATION OF THE EARTH.

The Globe. Owing to its nearly spherical form the earth can best be represented by means of a globe. On a terrestrial globe are marked the chief features of the earth, *viz.*, the continents, islands, oceans, countries, lakes, principal rivers, mountains, etc., to show their relative size, situation, and distance. Similarly the lines of latitude and longitude, the equator, the Tropics of Cancer and Capricorn, and the Arctic and Antarctic Circles are also shown. The ordinary structure of such a globe is as follows:—

1. A metallic rod passes through the centre of the artificial sphere. This rod represents the axis of the earth upon which it rotates from west to east in 24 hours.

2. The sphere is placed upon a stand in such a way that the inclination of the rod is the same as that of the axis of the earth to the plane of its orbit.

3. A metallic circle surrounds the sphere, to which it is attached at the extremities of the axis, which are called the poles. As all parts of the sphere, when it is rotated, pass under this circle, it serves as a general meridian, called the brass meridian. Degrees of latitude are marked on it.

4. The framework in which the globe is suspended is a circular wooden band. It divides the sphere into northern and southern hemispheres. As it represents the horizon, it is called the wooden horizon.

5. An hour-circle with a movable pointer or index,

which runs round the axis of the sphere, is attached to the north pole. It is divided into 24 equal parts, which represent the hours of the day.

6. To measure the distance of places and find their relative position a quadrant of altitude or movable plate of brass, divided into degrees, is screwed on the brass meridian.

7. The mariner's compass, which we have already described, is fixed under the sphere.

The Map. Though the globe is an exact representation of the earth on a small scale, it is not large enough to show the details of the features of the earth. If it were made of very large size it would be very expensive and inconvenient to handle. Therefore some more convenient form of representation is necessary. Such a form is a map. But maps are flat and the earth's surface is curved. A flat surface cannot coincide with or lie evenly on a curved surface. Take a sheet of paper and try to fit it on the surface of a sphere. The two surfaces cannot coincide unless the paper is crumpled at several places. To overcome this difficulty different methods are employed according to the purpose of the map and the size of the area to be represented, but all are based on the principle described below.

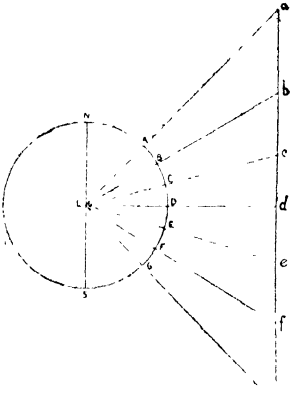
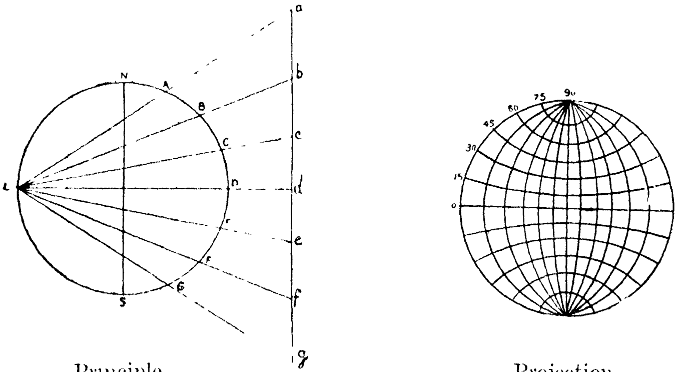


Fig. 14. -Projection.

Projection. In Figure 14 NDS is a hollow glass globe with A, B, C, D, E, F and G, seven trees painted in black upon it. L is the position of a lamp placed at the centre of the globe. A screen is put up at some distance from the globe. As soon as the lamp is lit, the light will throw the shadow of the black trees on to the screen. This throwing forward or projecting the features of the globe on to the flat surface of the screen is called *Projection.*

Kinds of Projection. Note in the last figure that the distances AB, BC, CD, DE, EF, FG, on the globe are all equal, but they are not so on the screen. They become greater as they get farther away from the centre. The rays LN and LS are parallel to the screen and therefore will not fall on it. Hence with the light in this position it is impossible to produce a map of a complete hemisphere. As already stated, different methods of projection are used according to the purpose of the map and the area to be represented. The most important projections are the following:—

1. **Stereographic Projection.** In this projection the light is supposed to be placed at the position L on the surface of the globe as shown in Fig. 15. The distances



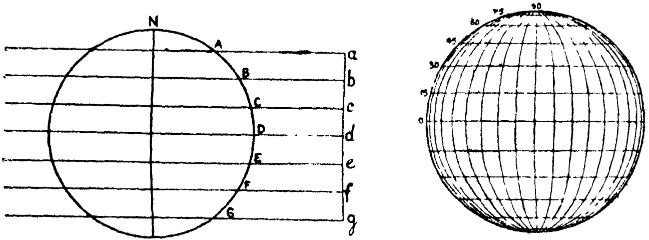
Principle

Projection

Fig. 15.—Stereographic Projection.

from A to G on the globe are all equal. The corresponding distances *a* to *g* on the screen gradually increase from the centre outwards. Therefore the parallels of latitude and the meridians, which are equidistant on the globe, become farther apart from one another on the map as they get away from the centre. Moreover, the parallels of latitude remain no longer parallel to one another as they are on the globe, but get curved as they reach the poles. Hence the map constructed by this method will show the central portions correctly, while the outer parts will be distorted in shape and enlarged in area. The map of the polar regions, which are the central portions of a hemisphere, is made by this method.

2. **Orthographic Projection.** In this projection the light is supposed to be placed at an infinite distance from the globe. All the rays of light will now be parallel, as shown in Figure 16. The distances A to G on the globe are all equal, while the corresponding distances *a* to *g* on the screen gradually diminish from the centre outwards. Therefore the parallels of latitude and the meridians draw together as they get away from the centre. Again, the parallels of latitude are no longer parallel

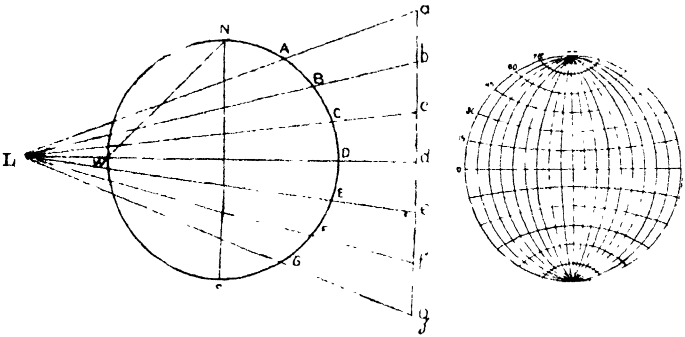


Principle. Projection.

Fig. 16 —Orthographic Projection.

circles as they are on the globe, but are parallel straight lines. Hence the distortion produced by this projection is just the reverse of that produced by the stereographic projection. This projection, like the stereographic, may be employed in producing maps of the central portions of the hemisphere, as of the polar regions. Otherwise these two methods are not of much value to geographers.

3. **Globular Projection.** As distortions of opposite kinds are produced by placing the light at infinity and at the surface of the globe, there must be some intermediate position where these distortions will nearly neutralize each other. This position is at the point L (Fig. 17).



Principle Projection

Fig. 17.—Globular Projection.

where LW is half of WN, that is half of the chord of the quarter-circumference. Observe that equal distances, A to G on the globe, are now projected as almost equal distances *a* to *g* on the screen. Therefore the parallels of latitude and the meridians are equidistant on a particular line as they are on the globe, but, unlike the former, are no longer parallel; they become curved towards the poles, diverging at the ends. This projection is therefore also known as the *Equidistant Projection.* Although distances are represented in this projection equally, the map is distorted at the edges and the direction is not shown correctly. This projection is generally used in making maps of the world in hemispheres.

4. **Cylindrical Projection.** Let us suppose that the screen is wrapped round the globe in the form of a cylinder and touches the globe at the equator. Imagine a light placed at the centre of the globe as shown in Fig. 18. The surface features of the globe will be projected on to the inner surface of the cylinder. Unwrap the cylinder and note that the lines of longitude, which on the globe meet at the poles, are parallel straight lines on the sheet. Parallels of latitude, which are circles on

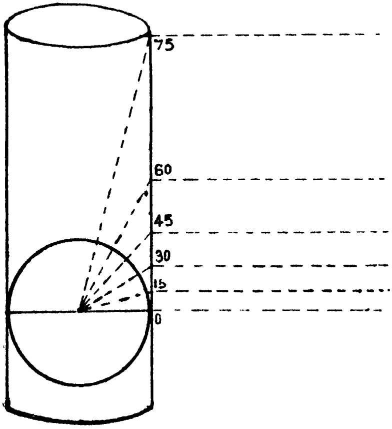


Fig. 18—Cylindrical Projection

the globe and which become shorter as they go towards the poles, are on the screen also straight lines equal in length. Moreover, the distance between them increases very much from the equator outwards, which is not the case on the globe. Therefore, except at the equator, the maps constructed by this projection will represent correctly neither the area nor the shape. But there is one advantage which outweighs these disadvantages. The lines of latitude and longitude are at right-angles to one another, as on the globe. Hence *direction* will be accurately represented.

5. **Mercator's Projection.** This projection is based on the cylindrical projection, which was modified in A.D. 1556 by a Flemish mathematician who called himself Mercator. We have seen in the cylindrical projection that the lines of longitude are equidistant straight lines, though in reality they converge at the poles. The parallels of latitude are equal in length and diverge from each other as they approach the poles, though in reality this is not the case. Thus the length of a degree of longitude is represented as being the same in all latitudes. But it is not so. At latitude 60° it is only half the length of a degree at the equator. In other words, the scale of the map, measuring east and west at latitude 60°, is double the scale at the equator. In order to preserve the correct ratio Mercator doubled the scale measuring north and south. (Fig. 19.) Thus on the map made on

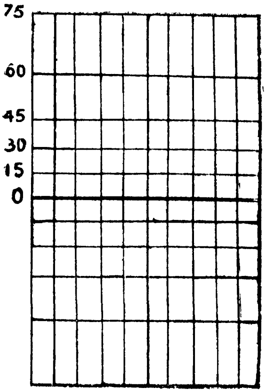
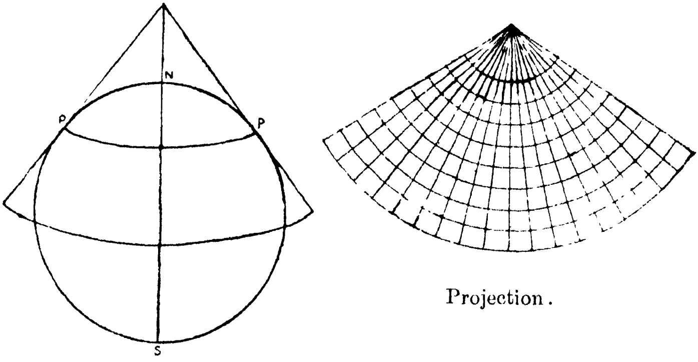


Fig 19 —Mercator's Projection.

this projection the distance from latitude 60° to 61° is made twice as great as from latitude 0° to 1°, though these distances are really equal. Hence, in addition to the correct direction, the shape of the countries will also be correctly represented. But their area in high latitudes will be greatly exaggerated. Thus Iceland looks nearly as large as Borneo, Greenland as large as South America, and Alaska as large as the United States, though in reality Iceland, Greenland, and Alaska are much smaller than Borneo, South America, and the United States respectively. Nevertheless Mercator's projection, though it gives no true idea of distances and areas (except near the equator), is of special importance to sailors, because it gives directions accurately. Hence seamen always use charts made on Mercator's projection.

6. **Conical Projection.** In this projection a cone



Prnciple.

Projection.

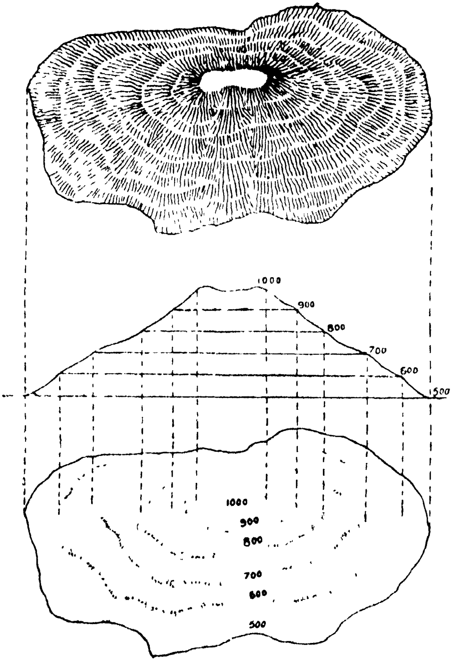
Fig. 20.—Conical Projection.

made of paper is supposed to be wrapped round the globe and the light is placed at the centre.

Its great advantage is that the curved surface of the cone, like that of the cylinder, can be spread out flat without any distortion; this is shown in Figure 20. But while the cylinder can come in contact with the globe only at the equator, the cone can coincide with it along any line of latitude. If the cone is spread out flat, the parallels of latitude will become parts of concentric circles, that is, they will be curved lines parallel to one another, and the lines of longitude will become converging straight lines at right-angles to the parallels. This projection is employed in making maps of separate countries and other relatively small areas.

Note that in the above examples the general principles of map-making have been illustrated. The globe and the light are not actually used in map-making. Maps are actually made by a method of measurement and mathematical calculation called *triangulation,* because the basis of all the calculations is the triangle.

How to Represent Elevation on the Map. Land relief, or different elevations of land as mountains, valleys, plains, is represented on the map in two ways: (1) by contours, (2) by hachures. (Fig. 21, 22). Contours are lines that join together places of equal elevation. Where the contours spread out, the ground is rather flat, and where they crowd together the ground is steep. Hachures are lines of shading. Where the slope is gentle the shading is light, and where it is steep the shading is heavy. Each method has its advantages. Hachures are much more impressive and the alterations of slope can be beautifully traced, but it is impossible to find from them the actual height of the places. Contours on the other hand are less picturesque, but they tell you exactly the height and slope of the places. In some maps varied shades of colour are also employed to indicate differences of elevation.



Figs. 21 and 22.—Hachures and Contours.

Scales. A map is always drawn to a certain scale, which shows the relation any distance on the map bears to the actual distance on the earth's surface. From it we can also determine areas. In using a map we should always know the scale on which it is drawn. This scale is sometimes indicated by a line of a certain length, say one inch, which may represent one or more miles. If the scale is one inch to one mile, then one inch on the map will stand for 63,360 inches of actual surface: hence this *scale* may be denoted by the *representative fraction* 1/63,360, or by the proportional figures 1:63,360. Such scales are useful when comparing one map with another in the atlas, as maps of the same size may represent very different areas. But they must be used with caution, for we have seen that projection can only give us maps that are true for the middle portion. For large distances and areas we must bear in mind the kind of projection by which the map is constructed and rely mainly on the meridians and parallels.

Exercises.

1. In what different ways may the earth be represented? Give the details of structure of a terrestrial globe.

2. What is a map? How does it differ from a globe? Why is the former used more largely than the latter?

3. Why is it impossible to draw a map accurately representing the earth's surface? What general principle is employed to avoid as far as possible the chief inaccuracies?

4. Explain the term "Map projection." What projections are used for the maps of the world?

5. Describe the Globular projection. What advantages does it have over the Stereographic and Orthographic projections?

6. What are the advantages and disadvantages of Mercator's projection? How far is it based on the Cylindrical projection?

7. What are Contours? What purpose do they serve on a map? How do they differ from Hachures?

8. Name the projections which you find most suitable for the following:—

(*a*) A map of the polar regions.
(*b*) A map of the Punjab.
(*c*) A map showing the British possessions in the world.
(*d*) A map showing the routes for steamers and air-ships.
(*e*) A map showing the comparative productions of cotton, coal, and rubber, and also the comparative density of population in the world.

9. What is meant by the scale of a map, and what use may be made of it?

CHAPTER IV.

THE MOON AND THE ECLIPSES.

The Moon. The moon revolves round the earth in an elliptic orbit in a little more than 27 days. Her mean distance from the earth is about 239,000 miles. her mean diameter is about $\frac{1}{4}$ of that of the earth; her surface is about 1/13, her volume about 1/49, and her mass about 1/81 of those of the earth. The force of gravity at her surface is about 1/6 of that of the earth. Thus, if a man weighing $1\frac{1}{2}$ maunds were transferred to the moon, he would weigh only 10 seers. For every revolution in her orbit she rotates once on her axis, so that the same portion of her surface is constantly turned towards the earth. She is also, like the earth, an opaque body and has no light of her own, but reflects the light of the sun.

The Phases of the Moon. All of us have seen that sometimes the moon appears in the sky as a crescent. This crescent gradually grows to a semi-circle and finally to a full round figure, which again diminishes from night to night till it ends in the new moon. These recurring changes in the appearance of the moon are called the *Phases of the Moon.*

How the Phases of the Moon occur. The moon revolves round the earth from west to east. Therefore she changes her position with respect to both the earth and the sun. When she comes between the earth and the sun, as at position A (Fig. 23), her dark half is towards the earth. Hence the people of the earth can

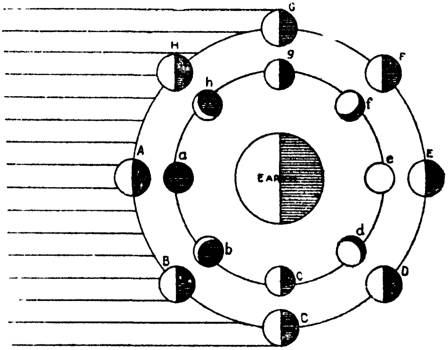


Fig. 23—Phases of the Moon.

see no part of her. This position of the moon is called the *New Moon.* When she moves to position B only a portion of her bright side appears to the people of the earth, as shown at *b* in the figure. This is the position of the *Crescent Moon.* She then appears in the western sky a little before sunset and sets soon after the sun. The crescent grows wider and the time of setting later by about one hour each day. When she comes to positions *C* and *G,* half of her bright side, or a quarter of the whole surface, is seen from the earth. These positions are called the *first quarter* and the *last quarter* respectively. The former takes place about seven days after the new moon, and the latter about twenty-one days after it. When she arrives at E, the whole of her bright side is towards the earth. This is called the *Full Moon* and takes place about fourteen days after the new moon. She rises in the east about the time of sunset and sets about the time of sunrise. From positions A to E her bright portion has been daily increasing in size. Therefore the moon is said to wax between the new moon and the full moon. For the rest of her course, *i.e.,* from positions E to A, she begins to wane or gradually diminish in size till she appears again as before. When more than a semi-circle is visible she is said to be *gibbous*, as at positions D and F. When less than a semi-circle is visible, she is said to be *crescent,* as at positions B and H. The moon goes through the above regular phases in a period of about 29½ days. From moon-rise to moon-rise is called a *lunar day* and the mean lunar day is 24 hours and 54 minutes.

The Time of Moon-rise and Moon-set Next Day. Had the moon been stationary, each place on the earth's surface would have come exactly opposite to her after 24 hours and the moon must have risen next day exactly at the same time. But the moon revolves round the earth from west to east, which is the direction of the earth's rotation. While the earth turns once on its axis, the moon moves from position *M to M'.,* (Fig. 24), *i.e.,* about 1/27 of her orbit. Hence the earth must turn through the additional angle MOM′ before the same place *A* can be opposite to it at *A′,* and the moon will conse-

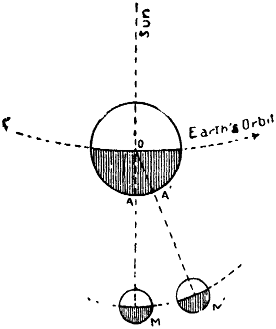


Fig. 24.—Varying Time of Moon-rise.

quently rise for the same place A after 1/27 of 24 hours, or about 54 minutes. Hence the time of rising and setting of the moon gets later each day by 54 minutes, or nearly an hour.

Solar Eclipse. At the time of New Moon, *i.e.*, when the moon comes between the sun and the earth (see Fig. 25), the light of the sun is obstructed by the moon.

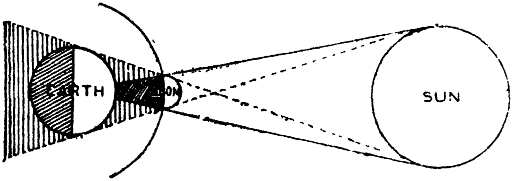


Fig 25 —Solar Eclipse.

The people on the earth cannot thus see the sun or any part of it and a solar eclipse is the result. If the sun is entirely hidden, this eclipse is called a *total eclipse;* and if it is partly hidden, we have what is known as a *partial eclipse.* In the figure the eclipse is total where the dark shadow falls upon the earth, for no part of the sun will be seen. It will be partial where the lighter shadow falls.

Sometimes the moon obstructs the centre of the sun. Then the central portion of the sun's disk is obscured and a bright ring is left round it. Such an eclipse is called an *annular* or ring-shaped eclipse of the sun. In

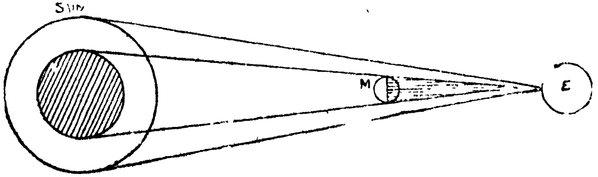


Fig. 26.—Annular Eclipse of Sun.

this eclipse the shadow of the moon does not reach the surface of the earth. (See Fig. 26).

Lunar Eclipse. An eclipse of the moon takes place at the time of full moon, that is, when the earth comes between the sun and the moon (see Fig. 27). The shadow of the earth then falls on the moon and a lunar eclipse is the result.

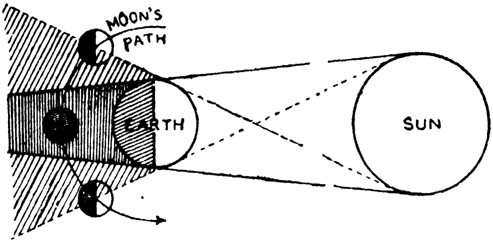


Fig. 27.—Lunar Eclipse.

Why Eclipses do not occur Every Month. We have just seen that the solar eclipse and the lunar eclipse occur at the time of new and full moon respectively. But as the new and the full moon take place once a month, how is it that these eclipses do not occur once every month? Had the moon's orbit been in the same plane as the orbit of the earth, *i.e.*, had the plane of the moon's orbit coincided with the plane of the earth's orbit, there would always have been an eclipse of the sun at new moon and an eclipse of the moon at full moon; each kind of eclipse would have occurred once every month. But this is not so. The plane of the moon's orbit is inclined at 5° to the plane of the earth's orbit. Hence an eclipse can occur only when the moon comes in the same plane as the earth's orbit, that is, when the sun, the earth, and the moon are in one straight line.

The Solar System. The solar system is the name given to indicate collectively the sun and the group of heavenly bodies which revolve round it as their centre. These heavenly bodies are planets, comets, and meteors.

The Sun. The sun is the central body of the system to which our earth belongs. Its diameter is 109 times that of the earth. It exceeds the earth in volume about 1,300,000 times and in mass about 330,000 times. Its mass is 750 times that of all the planets combined. It is about 93 millions of miles away from the earth; an airship with a constant speed of 100 miles an hour would take nearly 107 years to reach the sun.

The sun is an intensely hot body. The effective temperature of its surface is about 19,000° F. It gives us 7,000 million times the light of the brightest star, and in a year sufficient heat to melt a layer of ice 30 yards thick spread over the surface of the earth. But we get only a small fraction of the total heat radiated. If the sun were covered with ice 50 feet deep, the heat emitted would melt this in one minute.

Planets. Planets are heavenly bodies which revolve round the sun as their centre. The earth is therefore one of the planets. The planets look like stars from the earth, but they differ from stars in two respects: first, they change their places, while the stars do not; and secondly, they shine by reflected sun-light while the stars shine by their own light. The most important planets are: Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, and Neptune, of which we have already read in chapter I.

Satellites. A satellite is a secondary or smaller planet which revolves round a larger one. The moon is a satellite of the earth. Neptune is accompanied by one satellite, Mars by two, Uranus by four; Jupiter and

Saturn each by nine.

Comets. Comets are heavenly bodies which appear like stars accompanied by a train of light which is sometimes short, sometimes extending over half the sky. They revolve round the sun, not in a circular path, but in a long ellipse. They are, therefore, carried to such distances that they sometimes disappear for several generations. They seem to shine mainly by their own light, but part of their brightness is borrowed from the sun.

Meteors. Meteors are transient bright bodies seen in the atmosphere. These bodies shoot rapidly across the sky and then disappear. Hence they are also called shooting or falling stars. They are believed to be due to the existence of a great number of extremely minute bodies revolving round the sun; when these bodies happen to enter the earth's atmosphere they are heated by friction and become luminous.

Milky Way. The Milky Way, or the *Galaxy,* is the long white luminous track which is seen at night stretching across the sky from horizon to horizon. The bright track or belt is due to the existence of a multitude of stars so distant and so blended as to be distinguishable only by the most powerful telescopes.

Exercises.

1. What is meant by the phases of the moon? Explain with the help of a diagram how they take place.
2. "The time of rising and setting of the moon gets later each day by about an hour." Account for this fact.
3. How is the lunar eclipse caused? Why does it not occur once every month?
4. What do you understand by the total solar eclipse,

the partial solar eclipse, and the annular solar eclipse? Illustrate your answer by a diagram.

5. In what respects do comets differ from planets and stars, and why do they appear at such long intervals?

6. Write short notes on the following:—

Solar System, Meteors, Milky Way, and Satellites.

CHAPTER V.

LAND, AND AGENTS OF LAND CONFIGURATION

The Crust of the Earth and its Temperature. Scientists say that the earth was originally a nebula or glowing mass of intensely hot material revolving round the sun, of which it had formed a part. Subsequently its outer surface gradually cooled, condensed, and hardened. Even now the earth is very slowly losing its heat, while the sun is still in a glowing condition. This hardened surface of the earth is called its *Crust*. The crust is only 20 to 40 miles thick, or only 1/400 to 1/200 of the total diameter of the earth. The interior of the earth is still very hot. This is evident from the existence of volcanoes, which throw out molten matter, from geysers or springs of hot boiling water, and from the uniform rise of temperature in mines. On an average the temperature in a mine increases one degree F. for every 60 feet. Thus at a depth of a mile the temperature is about 100° higher than on the surface layer, and at a depth of 30 miles is high enough to melt any rock. But in spite of its very high temperature the interior of the earth is more or less solid. This is due to the great pressure of the rocks of the crust, for the increased pressure raises the melting-points of solids.

Rocks and their Formation. The various substances of which the earth's crust is composed are called rocks. This term applies equally to the hardest stone and to the softest sand. Rocks are divided into three main classes: (*a*) Igneous, (*b*) Aqueous, (*c*) Metamorphic.

(*a*) *Igneous Rocks* are those rocks which have been formed by the action of fire (Latin *ignis,* fire). They were originally in a molten state in the interior of the earth, but have subsequently cooled down and solidified. When they have solidified at great depths below the surface of the earth under great pressure they are called *Plutonic* (from Pluto, the king of the infernal regions). When they are thrown out in a molten state by volcanoes and cooled at the surface they are called *Volcanic,* as lava, basalt. The igneous rocks are generally shapeless and crystalline in character. As they are not formed in layers or strata they are also called *unstratified rocks.* They are found in India in the Raj Mahal Hills and the Deccan.

(*b*) *Aqueous Rocks* are those rocks which have been formed by the action of water (Latin *aqua,* water). Large quantities of igneous and other rocks are gradually worn away by the action of rain and rivers and deposited in layers in the beds of seas and lakes. Under pressure this mud or sediment is cemented together and forms a solid mass. As these rocks are found in layers or strata, they are called *stratified rocks,* and as they are formed by the sediment brought down by rivers they are also called *sedimentary rocks.* Sandstone is an example.

It sometimes happens that remains of plants or animals, such as leaves, branches, bones, teeth and shells, become buried in a sediment as it is being laid down. These remains are known as *fossils.* They are of value in deciding the age and mode of formation of the rock. Sometimes these remains of plants, animals and other organisms occur in large quantities, decay, and harden under pressure into strata of rocks. Such rocks are then called *organically-formed* rocks. Chalk, limestone, coal and coral are examples.

There is a third group of aqueous rocks known as *chemically-formed* rocks, as they are formed by chemical agency. Rock-salt and gypsum are examples.

(*c*) *Metamorphic Rocks* are those rocks which have been changed from their original form by heat or pressure. They are generally hard and crystalline in appearance. Gneiss (altered granite), marble (altered limestone), slate (altered clay), anthracite (altered coal) and quartzite (altered sandstone) are examples. In some cases the changes have been so great that it is difficult to discover the original composition of the rock.

Agents of Change. The changes which continually take place on the surface of the earth are chiefly due to two causes:—

(*a*) *Internal heat,* which causes movements of elevation or upheaval, and subsidence or depression of the earth's crust.

(*b*) *External agents,* which include rain, rivers, wind, frost, waves, glaciers, etc.

Internal Heat and the Formation of Mountains and Valleys. As the interior of the earth is hotter than its exterior, heat must travel from the former to the latter. As soon as it reaches the surface, it escapes into space. This process is called *terrestrial radiation,* and the interior of the earth is always losing its heat by this process.

As the interior of the earth gradually cools and contracts, the outer crust has to occupy a smaller space. The result is that the crust falls into wrinkles or folds (see Fig. 28).

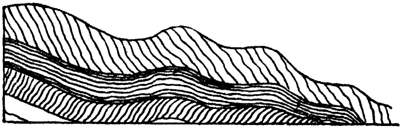


Fig. 28—Folding of Earth's Crust.

The raised parts are mountains and the depressed parts are valleys. Such mountains are called *Mountains of Elevation* or *Folded Mountains.* The Himalayas, the Atlas Mountains, the Alps, the Andes, and the Rocky Mountains are examples. At first sight it may seem strange that long and lofty ranges such as these should have been formed by the contracting of the earth and the wrinkling of its crust. But we must remember that the diameter of the earth is about 8,000 miles, while its highest mountain (Everest) is only about 5½ miles above sea level, that is, about 1/1450 of this diameter. If the earth were represented by an apple three inches across, then the height of Mount Everest above sea-level would be shown by 1/500 of an inch, a space which would be quite imperceptible to the naked eye.

There is another kind of mountain which is the result, not of elevation, but of "weathering," *i.e.,* wearing down the surface by weather, wind, rain, etc. Volcanoes throw up a large amount of molten matter from the interior of the earth. In course of time the softer parts wear away, while the harder part remains standing out from the general level. Such mountains are called *Residual Mountains,* and regions formed in this way are known as *Dissected Plateaus.* The Highlands of Scotland and of

Scandinavia are typical examples of such mountains and plateaus.

Sometimes the rocks are very rigid and hard, and when the earth's crust wrinkles, these rocks, instead of folding, crack and the strata then slip down on one side. Such cracks are called *Faults* (Fig. 29).

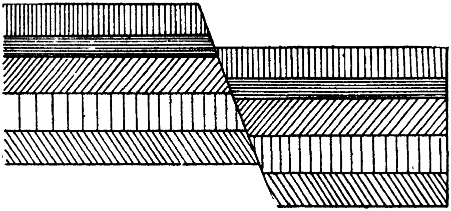


Fig. 29.—Rock Faults.

Sometimes the strata slip down between two more or less parallel faults as shown in Fig. 30. The depression caused in this way is known as a *rift-valley*. The Jordan and the Dead Sea, the Red Sea, Lake Nyasa,

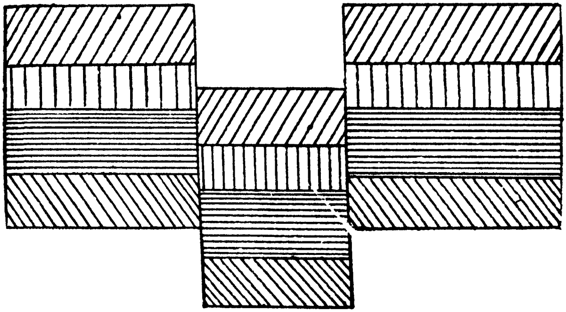
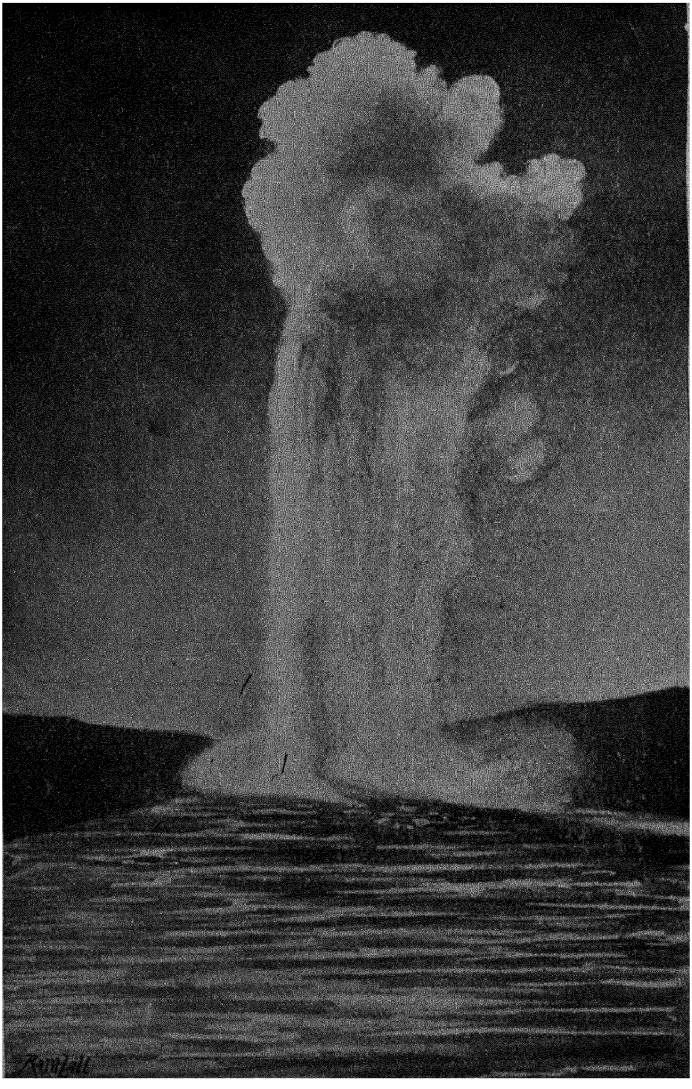


Fig. 30.—Rift-Valley.



A Geyser.

Lake Tanganyika, and the central plain of Scotland are all rift-valleys. Sometimes, on the other hand, a portion of the crust is left standing between two or more faults, while the surrounding country subsides. This crust is called a *Crust-block*. The island of Sicily is an example.

Volcanoes. During the crumpling and wrinkling of the earth's crust it sometimes happens that a deep opening is made. Water then passes through it, comes into contact with the highly heated rocks of the interior of the earth, and produces such a large quantity of vapour and steam that molten matter is forced up through the opening to the surface and is piled round it. A conical mountain formed in this way is called a *Volcano.*

Remember that a volcano is not a burning mountain. A volcano is a conical mountain built of material thrown out from openings in the earth's crust. The opening is called the *neck* of the volcano. The cup-like hollow at the top of the neck is called the *crater*. The molten matter which is forced up the neck of the volcano is called *lava.* Volcanoes that are in active operation are called *Active Volcanoes;* those that operate, not continually but at intervals of several years, are called *Dormant* or *Latent Volcanoes;* while those that have entirely ceased to act are known as *Extinct Volcanoes.* (See Fig. 31).

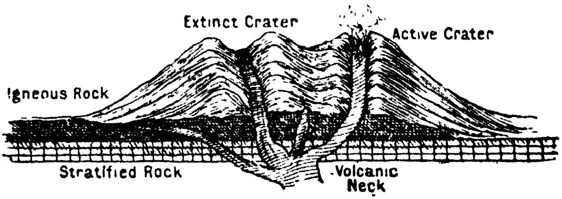


Fig. 31.—Diagram of a Volcano.

Geysers are springs of hot water which is thrown up, sometimes with dense clouds of steam and to a great height. Like volcanoes they are caused by the production of steam and vapour in the interior of the earth and are subject to intermittent eruptions. The high temperature of this water is due to its passing through the heated walls of the rocks, which are subjected to volcanic influences. Occasionally geysers show as mere pools of warm water. Geysers are mostly found in Iceland, New Zealand, and the Yellowstone Region of the United States. Sometimes the hot water of these geysers contains silica in solution. When the water evaporates, this mineral is deposited round the spring. This dry deposit is called *Sinter;* it has a bright half-transparent appearance. The famous pink and white terraces occurring in New Zealand and the Yellowstone Park district of the Rocky Mountains are formed of this sinter.

Earthquakes. An earthquake is a sudden shaking or heaving of the earth's crust, generally accompanied by a deep rumbling noise. This shaking may be a slight tremor or a violent convulsion. Earthquakes are believed to be due to the following causes:—

(*a*) When the interior of the earth cools and contracts, the crust cracks and a shaking is felt.

(*b*) Sometimes strata of rocks actually slip down along faults already formed.

(*c*) When water finds its way to the heated rocks of the interior, so much steam is produced underground that it expands and forces its way to the surface, and upheavals and tremblings take place.

Though earthquake shocks are felt more or less in all parts of the world, they are most common and most violent in volcanic districts and regions of folded mountains. They often accompany volcanic eruptions and cause heavy damage to life and property. In violent earthquakes the openings made in the ground are so extensive that entire cities and islands may be swallowed up. The earthquake wave which is produced by the sudden rush of the retreating sea upon the land is perhaps as destructive as the earthquake itself. Yet earthquakes may be constructive as well as destructive. They may bring up near the surface rocks containing useful minerals, and they may throw up new land for human habitation.

Rising and Sinking Coasts. Besides the sudden changes caused on the surface of the earth by volcanoes and earthquakes a slow movement, due to the gradual loss of heat and contracting of the earth, is always going on. Some parts of the earth are rising while others are sinking. The coasts of North America (California, British Columbia), Eastern India, Northern China and Japan are rising. The east coast of the United States, both sides of the English Channel, and the east coast of Australia are examples of sinking coasts.

Formation of Islands. Owing to the shrinking of the earth, sometimes a strip of land is separated from the continent by the subsidence of the intervening area into the ocean. Such strips of land are called *Continental Islands.* As they were once a part of the mainland, they are similar to the continent in geological structure, vegetation, and animals. Moreover, the water between the islands and the continent is shallow. The British Isles, Madagascar, New Zealand, and the Andamans are examples of such formation. Another kind of islands is known as *Oceanic Islands.* They are usually far from the continent and rise suddenly out of deep water owing to the upheaval of the earth. On account of their remoteness they are different from the mainland in geological structure, flora and fauna. Australia is the typical example. Oceanic islands also include a kind of island which is formed by tiny sea creatures called *Coral Polyps.* Such islands are therefore called *Coral Islands.* These creatures secrete the carbonate of lime which is dissolved in the sea-water and deposit it around their bodies to form a skeleton. In course of time this deposit of carbonate of lime accumulates, and comes to the surface of the water by the action of the waves. A chain of such islands is called a *Reef.* If a reef is near the shore, it is called a *Fringing Reef.* If it is at a greater distance, it is called a *Barrier Reef.* If it has a ring-like appearance surrounding a lagoon of shallow water, it is called an *Atoll.*

Exercises.

1. What do you understand by the crust of the earth? Show how it was originally formed.

2. What are rocks? Into what classes are they divided? Give a short description of each.

3. How would you prove that the temperature of the interior of the earth is high?

4 What is a volcano? How is it formed? Into what classes are volcanoes divided?

5. What is meant by an earthquake? Explain clearly how it is caused.

6. Distinguish continental islands from oceanic islands. Describe how each is formed.

7. What are geysers? What does their existence show? Where are they generally found?

8. Write short notes on:

Faults, crust-blocks, dissected plateau, atoll, sinter. fossils

CHAPTER VI.

EXTERNAL AGENTS OF CHANGE.

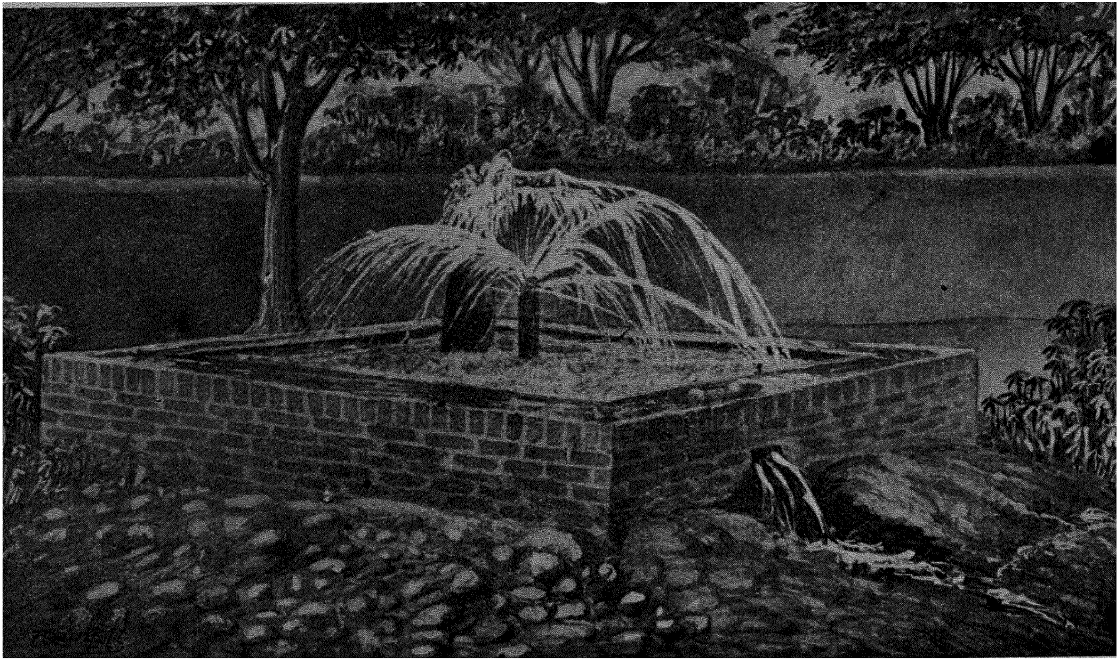
Denudation. In the last chapter we have read how the internal heat of the earth, by producing movements of elevation and subsidence of the crust, brings about changes on the surface of the earth. In this chapter we shall study how changes are caused by the external forces acting on the earth's surface. The chief of these forces are (*a*) Rain, (*b*) Rivers, (*c*) Ice, (*d*) Frost, (*e*) Wind, (*f*) Heat, and (*g*) the Sea. They are always gradually breaking up rocks, wearing away the softer parts, and carrying and depositing these at other places. This process of wearing away the surface of the earth and laying it bare is called *Erosion* or *Denudation.* Let us consider the action of each agent separately.

(*a*) **Action of Rain.** Rain acts upon the surface of the earth in three ways: (*i*) By falling upon the earth's surface it loosens parts of it and washes them away. (*ii*) On account of rain, rocks constantly get wet, then dry again, and in course of time break up. The particles of rock thus separated are carried away by the running water. Thus rain-water becomes muddy and removes the soil. (*iii*) The carbon dioxide present in the atmosphere is taken up by the falling rain-water. This causes the water, when it falls upon the rocks, to dissolve some of their constituents, such as carbonate of lime, and to form hollows and channels in them. Chalk, limestone, and marble are forms of carbonate of lime and are easily acted on by rain-water.

Stalactites and Stalagmites. When water which has carbonate of lime dissolved in it percolates through the roof of an underground cave each drop of water as it hangs on the roof partly evaporates, and carbonate of lime is left as a thin crust upon the roof. This gradually accumulates in the shape of hanging columns from the roof. These columns of limestone hanging from the roof of the cave are called *Stalactites.* The rest of the lime contained in the drops of water is deposited on the floor of the cave and in course of time forms into pillars which are called *Stalagmites.*

Formation of Springs and Wells. All the rain-water that falls on the earth is disposed of in three ways: (*i*) a part flows away into streams and rivers; (*ii*) a part is evaporated by the heat of the sun; (*iii*) the residue, of which there is a large quantity, sinks into the ground. The rocks which allow water to pass through them are called *permeable* or *pervious rocks*, such as limestone, chalk, sandstone. The rocks which do not allow water to pass through them are called *impermeable* or *impervious rocks,* such as clay, granite, etc. It is not necessary that permeable rocks should be soft rocks. Sandstone and limestone are hard enough for building purposes and yet water can pass through them. On the contrary, a layer of clay is comparatively soft and yet it does not allow water to go through it.

If a permeable rock lies upon a thick layer of impermeable rock, water will pass through the former but will be unable to penetrate the latter. Therefore it will accumulate and begin to flow above and along the impermeable rock until its own pressure forces the water out on the hillside at a point where the two rocks meet (see the point S in Fig. 32). Such an outflow of water is called a *Spring.*



An Artesian Well at Ludhiana.

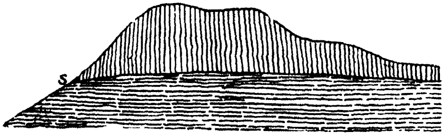


Fig. 32.—A Spring.

Springs may be *Perennial* or *Intermittent*, according as they flow throughout the year or during a part of it. When the permeable rock lies upon the impermeable rock in an inclined way as shown in Fig. 33, the water will

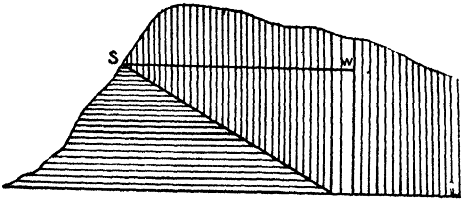


Fig. 33.—An Intermittent Spring and a Well.

cease to flow at S when the level of water falls below the line SW. Such a spring is called an *Intermittent Spring*.

If a sufficiently deep hole is made through permeable rock it will fill with water and will form a *Well*.

Artesian Wells. If a layer of permeable rock lies between two layers of impermeable rocks with both of its ends open as shown in Figure 34, the rain-water will pass through the open ends A and A′ and saturate the permeable rock. Now if a hole (W) is bored through the upper impermeable rock to the permeable rock, water will be forced to the surface by pressure. A well of this kind is called an *Artesian Well*. Such wells have

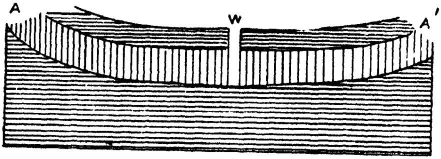


Fig. 34.—An Artesian Well.

been sunk in Quetta, Ludhiana, Queensland, South Australia, and various parts of the Sahra, where barren desert has thereby been changed into smiling gardens.

(*b*) **Action of Rivers.** Rain-water which has not evaporated and does not sink into the ground flows into streamlets which combine and form rivers. Such rivers do not run throughout the year. They go dry in the dry season. Rivers that take their rise from springs and lakes, or are fed by the melting of snow, flow all the year round. Both kinds of rivers are most effective in bringing about changes on the surface of the earth. They cause changes in three ways:—

(*i*) They eat into their beds and banks, thus deepening and widening themselves and forming valleys.

(*ii*) They carry the material thus separated from their banks and beds down to lower levels.

(*iii*) They deposit in their lower courses almost all the mud, silt, sediment, and other waste material, and form fresh land. Thus rivers are the great levellers of land and if there were no forces to counteract them they would in course of time reduce the earth's surface to one uniform level. Being rapid, they are purely destructive in the upper part of their course, called the *Mountain Stage.* Here their chief effect is to wear away their banks and deepen their beds. Thus they bring down numerous rock-fragments which by friction are ground into fine sand. In their middle course, called the *Plain Stage*, they deposit as much as they wear away. As here their speed slackens every obstacle turns their course aside, so that they tend to form into curves which are called *Meanders*. When the river is straight the current is most rapid along the middle of the channel, and slowest along the banks, so that deposits will occur along the banks and erosion in the middle. But when the course is meandering or winding, the current is swiftest on the outside of the curves and slowest on the inside of the curves. Therefore the bank on this outer side will be worn away, while sediment will be deposited on the inner side of the curves. Such new soil formed by deposits brought down by the river is known as *Alluvium*. Alluvial soil is very fertile. The whole of the Gangetic plain is made of this soil and hence its extraordinary richness.

Formation of a Delta. In the lower part of its course, called the *Delta Stage*, the river deposits more than it wears away, so that here its chief work is constructive. Its speed is very slow and it deposits all the mud and sediment which it has brought down. When it reaches the sea, this mud falls to the bottom. If there are no tides, the mud accumulates till in course of time

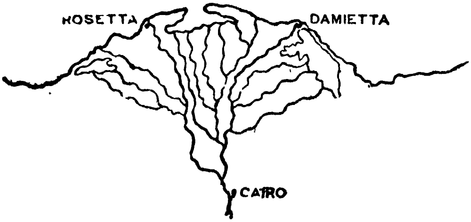


Fig. 35.—The Delta of the Nile.

it rises above the water level. The river then forces its way to the sea across this barrier through several branches called *Distributaries.* The triangular land thus formed at the mouth of the river is called a *Delta. Delta* (Δ) is a letter of the Greek alphabet and this name was applied by the Greeks to the delta of the river Nile from its triangular shape. (See Fig. 35).

Estuary. If the river falls into a sea where tides occur, it forms no delta, because the tides will not allow the mud and silt to accumulate there. No sooner is the mud deposited than it is washed away into the sea. Thus the mouth of the river will be kept wide and open. Such a wide-open mouth is called an *Estuary.* Rivers having estuaries are very useful for navigation, and flourishing ports are established on them, because ships can readily shelter from storms and other sea-dangers. The Ganges forms a delta, while the Thames and the Amazon form estuaries.

Basin, or Drainage Area. The whole area from which water drains into a river is called its *Drainage Area* or its *Basin.* It consists of not only the valley of the main river but also the valleys of all the rivulets and streams, with all their tributaries, that run into it. The ridge which divides one river-basin from another is called the *Water-parting.* An area the water of which runs into hollows and lakes that have no outlet is called an area of *Inland Drainage;* the Plateau of Seistan is an example.

(*c*) **Action of Ice.** Ice is frozen water and is, like running water, a powerful agent of change. Its action is seen in polar regions and among lofty mountains.

Snow-line. The temperature of the atmosphere decreases as we ascend above sea-level. In higher regions on account of intense cold there is snow instead of rain. The limit above which snow remains all the year round is called the *Snow-line.* The snow-line is not a fixed limit, but varies with latitude and other factors, such as rainfall, moist or dry winds, slope. Near the equator it is at a great height, but in polar regions it approaches the sea-level. The lowest height of the snow-line on the Himalayas is about 16,000 feet, while that on the mountains of Norway is about 5,000 feet. The Arctic Circle is covered with perpetual snow and the snow-line reaches the sea-level. It is well to remember that the snow-line of the Himalayas is 4,000 feet *higher* on the northern side than on the southern: the heavy rainfall from the Indian Ocean lowers the snow-line, while the drought and heat of Central Asia raise it.

Glaciers and their Formation. The snow that falls on the mountains above the snow-line accumulates. The upper layers compress the lower ones, which are thereby changed to half-snow and half-ice. Such a substance is called *névé.* Moreover, the snow at the surface melts during the day and forms water, which passes through the lower layers and during the night freezes them together. Thus gradually a compact mass of ice is formed. The force of gravity from below and the pressure from above cause the whole mass to slide down the valley like a river of ice. This slow-moving river of ice descending a mountain valley is called a *Glacier.* As the glacier moves down the valley stones and pieces of rocks fall upon it. This material collects and forms two long heaps at the sides of the glacier. These heaps are called *lateral moraines.*

When two glaciers unite, the two lateral moraines form into a central or *medial moraine.* The material heaped at the foot of the glacier is called a *terminal moraine.* Similarly pieces of rock fall into cracks of ice and are carried along the bottom of the glacier; they are called *ground moraine.* The glacier, together with its moraines, grinds into pieces even the hardest rocks over which it passes and thus scores out hollows and valleys. Such valleys are called *glaciated valleys.* Many of the valleys of the Himalayas and the Alps have been formed in this way. Thus we see that ice in the form of glaciers is a powerful agent of change.

When a glacier reaches a warm latitude it begins to melt and gives rise to rivers. The Ganges and the Jumna owe their rise to the Himalayan glaciers. In polar regions the glaciers reach the sea and break off into great masses, which remain floating. These huge masses of ice floating in the sea are called *icebergs.* Icebergs are very dangerous to ships; ships striking against them are broken into pieces. The *Titanic* was wrecked in this way in 1912.

(*d*) **Action of Frost.** Frost is the state of the atmosphere in which water freezes. When water or water-vapour freezes it expands. Crevices of rocks contain air and along with it the vapour of the atmosphere. On cold nights this vapour becomes frozen, and on freezing it expands and may break the rocks into pieces.

(*e*) **Action of Wind.** Wind is an important agent of change in deserts and sandy districts. Winds carry sand from one place and heap it up at other places in the form of long low ridges called *sand-dunes.*

Winds bring about change in another way also. In the form of sand-blasts they strike against the rocks and wear away the softer parts.

(*f*) **Action of Heat.** During the daytime rocks are heated and expand. At night they radiate heat and become cold and therefore contract. This alternate expansion and contraction causes rocks to break up gradually. It is in this way that rocks in deserts are reduced to sand.

(*g*) **Action of the Sea.** The sea is never still; there are always waves and currents in it. As the waves beat against the coasts, they wear away the softer parts and make bays and bights. The harder parts remain as projecting headlands and capes. The softer parts are worn away and deposited by the sea at other parts of the shores: thus extensions of the coast line take place. Again, the constant friction of water against the base of cliffs detaches their summits and in this way wave-cut platforms are formed.

Exercises.

1. The land surface of the earth is constantly undergoing change. What are the chief external agents of change? Describe the kind of work done by any two of those you mention.

2. How do rain and rivers bring about changes on the surface of the earth?

3. Explain clearly how springs are formed. How many kinds of springs are there ?

4. What are artesian wells? How are they formed? Illustrate your answer by a diagram.

5. What is a delta and how is it formed?

6. What is a glacier? How is it formed? Explain its action upon the rocks over which it passes.

7. Explain the action of frost and heat and the sea in bringing about changes on the surface of the earth.

8. Write notes on—

Snow-line, area of inland drainage, estuary, glaciated valleys, icebergs, meanders, and denudation.

CHAPTER VII.

THE OCEAN AND ITS CURRENTS.

Sea-water and its Saltness. Rivers falling into the ocean bring, dissolved in their waters, such substances as sodium chloride (common salt), carbonate of lime, potassium and silica. A large quantity of the last three is used up by marine animals in order to form their shells and skeletons. The common salt, which is not so used, is left behind and makes the water salty. This saltness differs in degree in different parts of the ocean. Those parts where the evaporation is greater and the supply of fresh water less, are salter than those where the conditions are reversed. Thus the Mediterranean and the Red Seas are much salter than the Baltic and the Black Seas. Again, owing to the constant supply of fresh water by rainfall and rivers, the surface water of the ocean is less saline than its deep water.

Its Temperature. Just as all parts of the ocean are not equally salt, so they are not uniform in the degree of temperature. Near the equator the temperature of the surface water is the highest (about 80 degrees F.) and gradually decreases as we approach the poles, where it is 28 degrees F. Again, closed seas have a higher and more uniform temperature than open seas. Though the surface temperature varies greatly, it has been found that at very great depths the ocean keeps everywhere an almost uniform temperature Compared with the land, the ocean has a more equable temperature. The reason is that water becomes heated very slowly, and when once heated cools bery slowly. On the other hand land is heated rapidly and also cools quickly.

Movements of the Ocean. The chief movements that take place in the ocean are (*a*) waves, (*b*) currents, (*c*) tides.

Waves. Waves are mere ridges or undulations on the surface of water. They are produced by winds and sometimes by the trembling of the earth on account of earthquake's. It should be remembered that in waves there is no forward movement of water. The particles of water merely rise and fall, and at last return to the position from which they started; compare the movement of a rope which is shaken at one end but does not change its place. That there is no forward movement of water in waves will be evident if we place on the surface of a wave a small piece of wood; it will toss up and down, but will not be carried forward. When large waves approach a shore or shallow place their lower part is checked and the upper part falls forwards with great force; such broken waves, topped with white foam or surf, are called *breakers.* A gentle wave is called a *ripple,* which is a mere ruffling of the surface of the water.

Currents. A current is a flow of water in the ocean from one part to another; it is like a river in the sea. Currents may be at a great depth or at the surface. Those that are at the surface and are produced by the prevailing wind are called *drifts.* Remember that currents are named after the direction *to* which they flow. An easterly current is one which flows towards the east. On the contrary, winds are named after the direction *from* which they blow. A west wind means a wind blowing from the west.

The existence, force, and direction of currents have been found out in various ways. A common method is to note the direction taken by floating objects. Thus sealed bottles, containing information of the place and date of their despatch, may be sent adrift; they may be carried long distances before they are picked up and their message read. Sir James Clark Ross, who explored the Antarctic seas, sent afloat a number of such bottles in 1842 near Cape Horn, and one of these was picked up in 1845 near Port Phillip in Australia. Before wireless telegraphy was invented news of shipwrecks occurring in the heart of the ocean often reached other parts of the world in this way. It is clear, therefore, that the waters of the ocean may travel forward over immense distances.

Humboldt, the great explorer, calculated that a drop of water in the Gulf Stream would return in about two years and ten months to the place from which it originally started. A boat, without being propelled by wind or artificial means, would drift by the force of the current from Florida to Newfoundland in about fifty days.

Causes of Currents. Currents are produced or modified by the following factors, acting singly or together.

(1) *Unequal Temperature.* The rays of the sun are more nearly vertical near the equator than near the poles. Therefore water in the equatorial regions is warmer than that in the polar regions. This warm water flows towards the poles as a surface current, and to take its place the cold water of the poles flows south as an undercurrent.

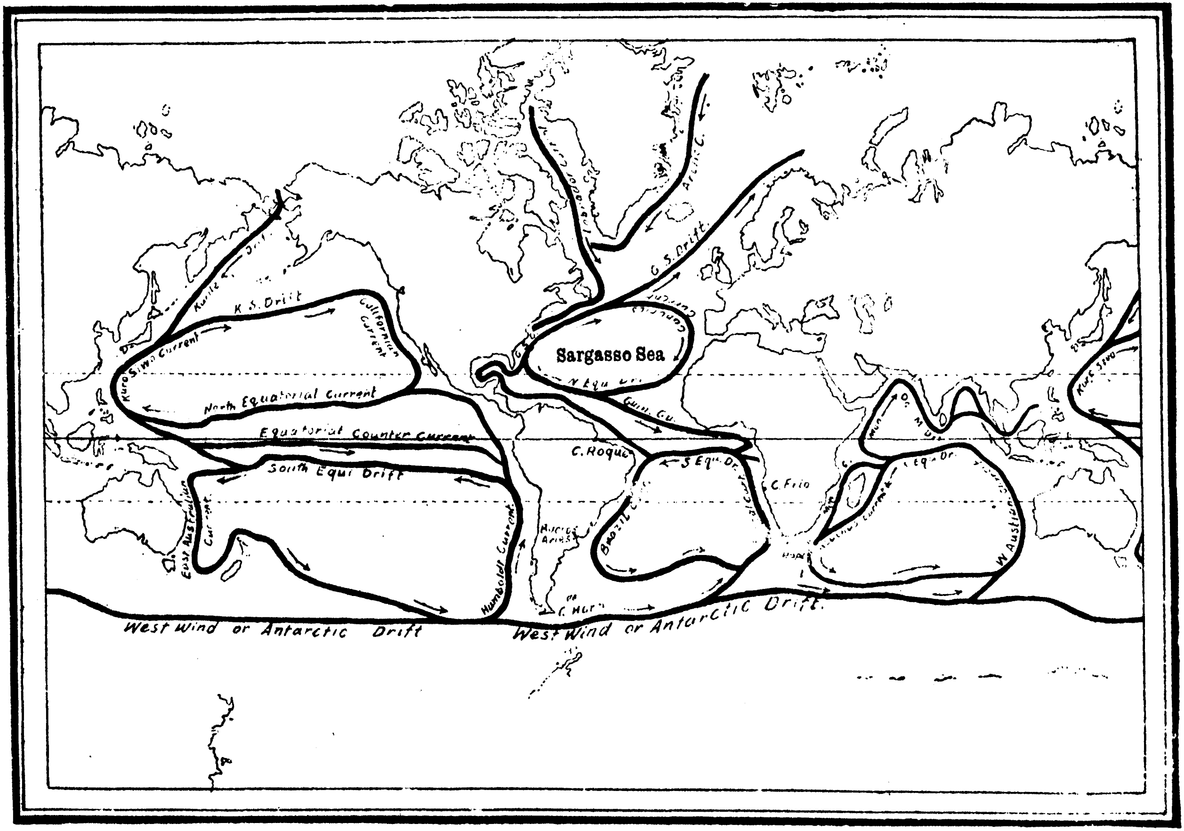
(2) *Unequal Density.* As the water in the polar seas freezes into ice, the remaining water becomes salter and consequently heavier. This heavier water sinks down and flows as a deep-water current, and to keep up the

equilibrium warmer water from the equatorial regions comes in as a surface current.

(3) *Unequal Evaporation.* We have already read that in regions where the evaporation is greater or the supply of fresh water less, a current flows in from other places to make up the deficiency of water thus caused. Thus the Mediterranean Sea, which is wide and is situated near the Sahra and has therefore active evaporation from its surface, receives currents from the Atlantic and the Black Sea. On the other hand the Baltic Sea sends out a current, because evaporation is small and the supply of fresh water great.

(4) *Prevailing Winds.* If winds blow constantly in one direction, they carry the surface water in the same direction. Thus the prevailing winds are a great force in producing surface currents or drifts. In the region of the trade-winds, which blow from north-east and south-east, the ocean currents flow towards the west. In the region of the anti-trade winds or "Westerlies" the currents flow towards the east.

(5) *Rotation of the Earth.* Though the rotation of the earth is not directly the cause of currents, it modifies their direction and splits them up into branches. This happens in the following way. The earth rotates from west to east, and has greater velocity at the equator than at places north or south of it. Therefore currents coming towards the equator from the northern hemisphere are turned towards their right, while those from the south are turned towards their left. This law was first discovered by a scientist named Ferrel and is known as Ferrel's Law. Thus the North Equatorial Drift in the Pacific Ocean turns to its right as the Japan Current, and the South Equatorial Drift turns to its left as the South Australian Current.


Kuro Siwo Current
Kurile C.
Drift
K. S. Drift
Californian Current
North Equatorial Current
Equatorial Counter Current
South Equi Drift
East Australian Current
Humboldt Current
West Wind or Antarctic Drift
Labrador Current
Arctic C.
G. S. Drift
Canaries Current
Sargasso Sea
N. Equ. Dr.
Guin. Cu.
C. Roque
S. Equ. Dr.
Brazil C.
C. Frio
Buenos Aires
C. Horn
West Wind or Antarctic Drift.
Mon. Dr.
S. Equ. Dr.
W. Australian Current
Kuro Siwo

(6) *Configuration of the Land.* The wedge-like projection of the coast of Brazil checks the warm North Equatorial and the South Equatorial Drifts and sends the former towards the north as the Gulf Stream, and the latter towards the south as the Brazilian Current But for this interruption the North Drift would have flowed straight on and there would have been no Gulf Stream.

Kinds of Currents. Currents are of three kinds, *viz.*, (1) Constant, (2) Periodical, (3) Local. Constant currents are those which flow in the same direction throughout the year, as the Gulf Stream. Periodical currents are those which flow for a certain period in one direction and for the rest of the year in another. They change their direction as the direction of the winds which produce them is changed. Thus the north-east and the south-west monsoons produce periodical currents in the Indian Ocean. Local currents take place in enclosed seas, as the current of the Mediterranean Sea. Of the three the constant currents are the most important. Let us study them separately.

Currents of the Atlantic Ocean:—

(1) *West Wind or Antarctic Drift* is a cold current flowing from Cape Horn to the Cape of Good Hope. As it is under the influence of the "Westerlies," it is called the West Wind Drift, and as it is near the Antarctic Ocean it is also named the Antarctic Drift.

(2) *South Atlantic or Benguela Current* is a cold current flowing from the Cape of Good Hope to Cape Frio on the west coast of South Africa. It is thus a continuation of the West Wind Drift.

(3) *South Equatorial Drift.* Starting from where the Benguela Current ends this current flows, under the influence of the trade-winds and the rotation of the earth, along the equator as a warm drift. At Cape St. Roque on

the coast of Brazil it is divided into two branches. One branch goes towards the south and the other branch goes to the north. This drift is about 4,000 miles long and 450 miles broad at the point of division. Its average temperature is about 75° F.

(4) *The Brazilian Current* is the south branch of the South Equatorial Drift and is a warm current. It flows along the coast of Brazil up to Buenos Ayres, where it turns towards the east and joins the West Wind Drift a little south of the Cape of Good Hope.

(5) *Gulf Stream.* The north branch of the South Equatorial Drift, after parting from the Brazilian current at Cape St. Roque, enters the Caribbean Sea, passes round Cuba, and issues from the Gulf of Mexico as the famous Gulf Stream. Here it is a deep wide current of dark-blue warm water flowing at the rate of about four miles an hour. Its temperature is 86° F., or 9° above that of the ocean in the same latitude. Near Florida it is joined by the North Equatorial Drift. At first it flows parallel to the coast and gradually becomes wider, shallower and cooler. Near the southern coast of Newfoundland it turns towards the north-east under the influence of the south-westerly winds. It then disappears as a definite current and becomes the Gulf Stream or North Atlantic Drift. When about half-way across the Atlantic it is divided into two branches. One goes towards the south of the coast of Portugal. The other goes straight on, passes along the western shores of the British Isles, and then flows along the coast of Norway. It is owing to this warm current and its influence upon the winds flowing over it that England enjoys a mild climate and the harbours of Norway remain open throughout the year, while those of Greenland in the same latitude are closed with ice. Of

all the Atlantic currents the Gulf Stream is the most important.

(6) *North Equatorial Drift* is a surface current of warm water flowing along the north of the Equator, just as the south Equatorial Drift flows along the south of the equator. As already stated, it joins the Gulf Stream near Florida.

(7) *Canaries Current* is a branch of the Gulf Stream Drift. After flowing by the shores of Portugal and north-western Africa it joins the North Equatorial Drift and thus completes the great round. The still water covered with floating sea-weed and other grasses lying within this whirl is called the Sargasso Sea.

(8) *Guinea Current, or the Equatorial Counter-current*, is the result of surplus water heaped up by the North and South Equatorial Drifts near the north-east coast of South America.

(9) *Arctic Current* is a cold current and flows along the east coast of Greenland. It joins the Labrador Current.

(10) *Labrador Current* is also a cold current and, flowing along the east coast of North America, meets the Gulf Stream coming from the south. As a result of the meeting of these cold and warm currents fogs are produced.

Currents of the Pacific Ocean:—

(1) *West Wind or Antarctic Drift* is a cold current which flows from the Antarctic Ocean towards the western coast of South America.

(2) *Humboldt or Peruvian Current* is a cold current which flows northward along the west coast of South America. It corresponds exactly to the Benguela Current which flows along the west coast of South Africa. The result is that in both the continents the west coasts are

much cooler than the east coasts.

(3) *South Equatorial Drift* is a continuation of the Peruvian current. Being near the equator and under the influence of the trade-winds it flows towards Australia as a drift of warm water. Near the east coast of New Guinea it is divided, as in the Atlantic Ocean, into two branches, one going to the south and the other to the north.

(4) *East Australian or New South Wales Current* is the south branch of the South Equatorial Drift and flows along the east coast of Australia as a warm current. It corresponds to the Brazilian Current.

(5) *Kuro Siwo or Japan Current.* The north branch of the South Equatorial Drift, after parting from the East Australian Current, flows northwards to the east coast of Japan as a current of warm water under the name of Kuro Siwo or Japan Current. From Japan onwards it comes under the influence of the "Westerlies," changes into a drift, and touches British Columbia on the west coast of North America. This current exactly corresponds to the Gulf Stream, both in its course and in its effect.

(6) *North Equatorial Drift* is a surface current of warm water flowing from Mexico along the north of the equator to the East Indies. It joins the Kuro Siwo near the Philippines.

(7) *Californian Current* is a branch of the Kuro Siwo Drift. It flows southward along the coast of California and rejoins the North Equatorial current.

(8) *Equatorial Counter-current* is similar to the current of the same name in the Atlantic Ocean and is the result of the same cause.

(9) *Kurile Current* is a current of cold water and flows southwards through Bering's Strait and the channels

of the Kurile Islands, whence it takes its name.

Currents of the Indian Ocean:—

(1) *West Australian Current* is a cold current. It is a part of the Antarctic Drift and flows northwards along the west coast of Australia. It corresponds exactly to the Benguela and Humboldt currents.

(2) *South Equatorial Drift* is a current of warm water flowing from Australia to Madagascar along the south of the equator. It corresponds to the drifts of the same name in the Atlantic and Pacific Oceans. Near Madagascar, it is divided into two branches, one going to the south and the other to the north.

(3) *Mozambique Current* is the southern branch of the South Equatorial Drift. Passing through the Mozambique Channel it flows along the east coast of South Africa, where it is known as the Agulhaus Current. Then under the influence of the westerly winds it rejoins the West Australian Current.

(4) *Periodical Currents.* North of the equator the currents of the Indian Ocean are determined by the south-west and north-east monsoons, and are therefore periodical currents. They are known respectively as the North-east and South-west Monsoon Drifts.

From the above description of the various currents in the three great oceans it is clear that they are all parts of the vast oceanic circulation of the globe, and must be studied in relation to one another.

Influence of Currents on Climate and Commerce.

(1) By their continuous motion currents help to keep the water of the ocean pure and fresh.

(2) The temperature of places is raised or lowered according as they are situated near warm or cold currents. Labrador and the British Isles lie almost in the same latitude; yet the former remains frozen for most of the

year on account of the cold Labrador current, while the latter enjoy a mild and equable climate throughout the year on account of the warm Gulf Stream Drift.

(3) Warm air can contain more water-vapour than cold air. Therefore winds which come in touch with warm currents are laden with water vapour and give abundant rainfall to the places where they blow. Thus Japan, which is under the influence of the warm Kuro Siwo, gets more rainfall than Kamchatka Islands, which are under the influence of the cold Kurile current.

(4) When warm and cold currents meet, fogs are the result. Thus the climate of Newfoundland, where the cold Labrador current meets the warm Gulf Stream, is foggy.

(5) Warm currents keep harbours free from ice and thus trade can be carried on there throughout the year. But for the warm Gulf Stream the harbours of Norway would remain closed for a large part of the year.

(6) Currents help ships sailing in the direction of their flow, and shipmasters choose their course accordingly. Thus ships going from England to Australia cross the Atlantic Ocean a little south of Rio de Janeiro so that they may take advantage of the force of the Brazilian Current, which joins the Antarctic Drift near the Cape of Good Hope.

(7) The most important food-fish (cod, herring, etc.) live in cold water, and are brought by cold currents to warmer regions, as to the shores of Newfoundland, Japan, and South Africa.

(8) Currents also help to keep alive those animals and organisms which live at great depths. Oxygen is as necessary to life in the ocean as on the land. Currents, by moving and circulating the waters of the ocean, carry

oxygen from the surface to the lower depths. Had there been no vertical movement of the water the oxygen at great depths would soon have been exhausted and all deep-sea organisms would have perished.

Exercises.

1. Why is sea-water salty? Why does this saltness differ in different parts of the sea?
2. What are waves? Distinguish them from currents.
3. How are ocean currents caused? Into what classes are they divided?
4. Compare the currents of the Atlantic Ocean with those of the Pacific and state the points of similarity.
5. Trace and describe the course of the Gulf Stream, and compare it with the Kuro Siwo as regards direction and influence.
6. What countries are influenced by the Gulf Stream? Of what special benefit is it to the British Isles?
7. Show the relation which exists between permanent winds and the main ocean currents.
8. Describe the influences of currents on climate and commerce.

CHAPTER VIII.

THE TIDES.

What Tides are. Tides are the gradual rise and fall of the waters of the ocean at definite intervals in regular succession. The rise of the water is called the *flow* of the tide, and the fall of the water is called the *ebb* of the tide. The sea rises or flows for about six hours, and then the fall or ebb begins and continues for six hours more. Again the flow and the ebb return as before, so that in about 25 hours the rise and fall each occur twice. Remember that in the tides, as in waves, there is no advance of the water itself, but like the undulations of a flag the water rises and falls. Unlike currents and waves, tides affect the whole ocean from the surface down to the lowest depth. An ordinary wind-wave is unable to displace the smallest grain of sand at a depth of 1,200 feet.

How Tides are Caused. All bodies attract one another with a force which is directly proportionate to the product of their masses and inversely proportionate to the square of their distance. Thus the greater the quantity of matter in a body, the stronger is its attraction; and the greater its distance, the less is its pulling force. This force is known as *gravitation.* According to this force of gravitation both the moon and the sun are exerting their attraction on the solid earth, as well as on the water which surrounds it. But the moon's attraction is much greater than that of the sun. The reason as stated before is that, although the sun is of much greater mass, its distance from the earth is very much greater than that of the moon. The sun's mass is nearly 27,000,000 times the moon's mass, and the sun's distance is about 390 times the moon's distance. Consequently, in the production of the tides the sun's force is to the moon's force in the proportion of about 5 to 11; the moon is therefore the principal cause of the tides.

In Fig. 36 E is the centre of the earth, which is enclosed all round by water represented by T, L, T′, L′. Now the moon is exerting her attraction simultaneously at T, L, T′, L′. But because T is water which can move freely, unlike the earth, and is nearer to the moon than E, the attraction of the moon is greater at T than at E. Therefore the water at T, not being rigidly connected with the earth, is drawn out and produces a high tide. Again, E is nearer to the moon than T′; hence the centre of the earth is attracted more strongly than the water at T′ which, not being rigidly connected, is

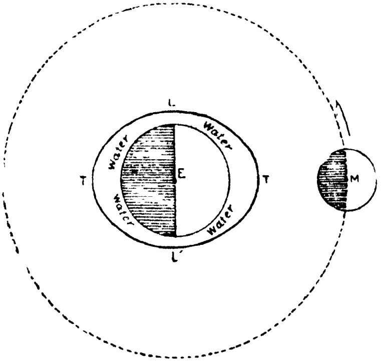


Fig. 36.—How Tides are caused.

left there as high water. Thus two high tides occur at the opposite sides T and T′ simultaneously. At L and L′ will occur two low tides at the same time, because some of their water will flow to T and T′.

Had the earth been stationary with respect to the sun and the moon, the tides would also have been stationary. But as the earth turns upon its axis, every place is brought directly opposite the attracting force. Thus the rising of the water becomes a great tidal wave or flow which travels round the globe, each place on the sea having a rise and fall of water at an interval of about six hours.

Time of the Corresponding High Tide Next Day. The time of high tide depends on the time of moon-rise and moon-set, which has already been explained in Chapter IV. It will be useful to restate the argument. Had one of the two, the earth or the moon, been stationary, each place on the earth would have come exactly opposite to the moon after 24 hours, and the corres-

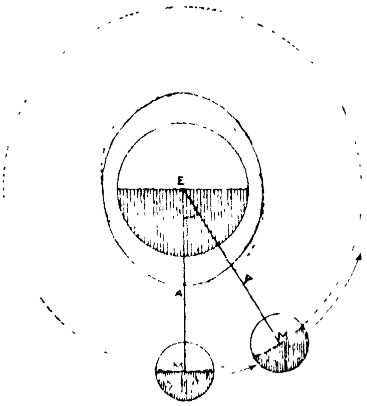


Fig. 37.—Why Time of High Tide varies.

ponding high tide next day would have occurred after exactly 24 hours. But the moon revolves round the earth from west to east, which is the direction of the earth's rotation. While the earth turns on its axis the moon moves from the position M to M′ (see Fig. 37), *i.e.*, about 1/27 of her orbit. Hence the earth must turn through the additional angle MEM′ before the same place A will be opposite to it at A′. The time taken by the earth in turning through this additional angle will be 1/27 of 24 hours or about 54 minutes. Hence the corresponding high tide next day occurs not after 24 hours but after 24 hours and 54 minutes, or approximately after 25 hours.

Spring Tides. We have read that the sun also exercises an attractive power on the earth and its waters, although that of the moon is the greater on account of her nearness. At new moon and full moon the sun and the moon are in line with the earth and therefore they

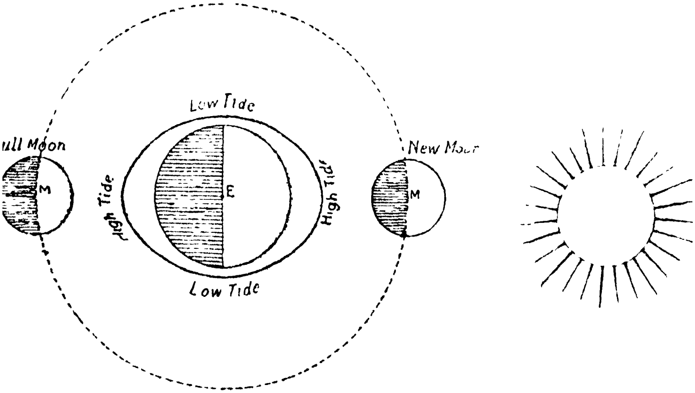


Fig. 38.—Spring Tides.

exert a joint influence. Consequently the high tides produced are higher than usual and the corresponding low tides lower. Such high tides are called *Spring Tides.* They occur at intervals of a fortnight. (See Fig. 38).

The Spring Tides do not usually occur exactly at the time of new moon or full moon, but after an interval. Thus, at London, the Spring Tide occurs two and a half days after new or full moon, and the Neap Tide is similarly delayed. This interval is called the *Age of the Tide.* The height of the Spring and Neap Tides varies with the changing distance of the Moon from the Earth; when the Moon is nearest the Earth the Spring Tide is specially high.

Neap Tides. At the first and last quarters of the moon, the sun and the moon are at right-angles to each other. Therefore the attraction exerted by the one largely counteracts that of the other. Consequently the tides

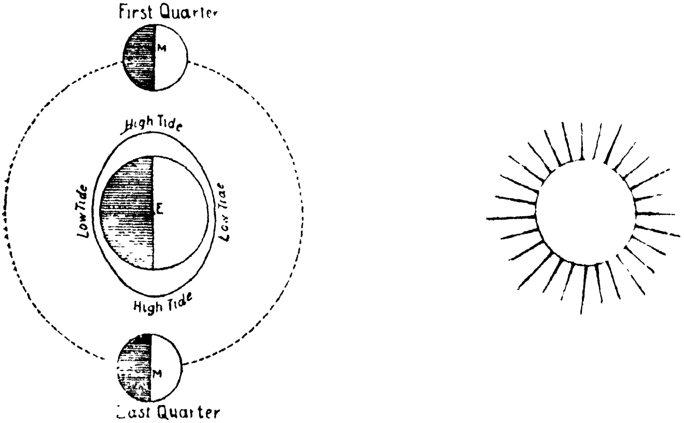


Fig. 39.—Neap Tides.

produced are lower than usual. Such low tides are called *Neap Tides.* They also occur twice in a month. (See Fig. 39).

Height and Speed of the Tides. The height and the speed of the tides depend upon the depth of the ocean and the configuration of the land. In the central part of the ocean the tides scarcely rise beyond two or three feet, but in shallow seas and gulfs and gradually narrowing and shallowing channels they rise very high. The reason is that, while the lower part of the tidal wave is checked, the water from behind continues to pour forward and heap itself up higher and higher. Thus the tides rise very high round the British Isles where the sea is shallow. In the Bay of Bengal and the Bay of Fundy (between New Brunswick and Nova Scotia) they rise from 20 to 60 feet. On the other hand, inland seas and gulfs whose openings are narrow and lie obliquely to the course of the tidal wave are almost tideless, such as the Mediterranean and the Baltic Seas. The difference between average high and low water is called the *Range of the Tides.* At New York it is about 6 feet and at London Docks about 19 feet.

When tides directly meet funnel-shaped estuaries, that is, mouths of rivers which become gradually narrow and shallow as they go inland, there occurs a violent uprush of water. This high wall of water, caused by the conflict between the river current and the tidal wave rushing violently up the river, is called a *Bore.* Bores occur in the river Tsien-Tang (30 feet high), the Hugli (25 feet), the Amazon (13 feet), the Garonne (12 feet), and the Severn (9 feet).

The velocity of the tides is greatest where the ocean is freest and deepest. In the free depths of the Southern Ocean this velocity is about 1,000 miles per hour, while in restricted seas like the North Sea the speed is hardly one-twentieth of that amount. The lines which join places having the high-water mark at the same time are called *Co-tidal Lines.*

Importance of Tides. The tides are of great importance to man for the following reasons:—

(1) By carrying away from the mouths of the rivers the silt and mud brought down by them, they prevent the waterways from being blocked up and thereby render rivers navigable that would not otherwise be so.

(2) By increasing the depth of water near coasts at the time of their flow, they enable ships to enter ports where they would otherwise have been obliged to remain outside. They thus help trade by enabling seaports to be built in sheltered positions easily reached on the land side as well as by sea.

(3) By keeping the ocean in constant motion and mixing the salt-water of the sea with the fresh water of the rivers, they prevent its water from freezing and from stagnating.

(4) By carrying away into the heart of the ocean the refuse and rubbish brought down by rivers hey act as scavengers and thus improve the sanitation of places situated on or near the sea. The public health in countless cities, towns, and villages owes much to the cleansing action of the tides.

Exercises.

1. What are the tides ? In what respects do they differ from currents and waves?

2. Why is the moon's power in producing tides greater than the sun's, although the latter is much larger?

3. Explain by means of a diagram how tides are caused.

4. What do you understand by spring tides? Describe with the help of a diagram how they take place.

5 What are neap tides and how are they caused?

6. Say what you know about the speed and height of tides.

7. Explain why the corresponding high tide next day occurs, not after 24 hours, but after 24 hours and 54 minutes.

8 What is a bore? Where do bores generally occur? Give instances.

9 Why are the tides of great importance to man?

10. Explain the following:—

Range of the tides, co-tidal lines, high tide and low tide.

CHAPTER IX.

THE ATMOSPHERE AND ITS CIRCULATION.

Composition of the Atmosphere. The atmosphere is the gaseous covering which completely surrounds the earth. It extends to a great height, about 200 miles, but grows less and less dense with elevation. It consists mainly of one-fifth oxygen and four-fifths nitrogen. Besides these two gases, it contains a small quantity of carbonic acid gas and a certain amount of water-vapour. This last-mentioned constituent, *i.e.*, water-vapour, is very important from the geographical point of view.

Moisture of the Atmosphere. The water of oceans, rivers, and lakes is always being turned into invisible vapour by the heat of the sun. This process of turning water into vapour is called *Evaporation*. As vapour is lighter than air, it is carried by winds and spreads through the atmosphere. The amount of water-vapour which the air can hold depends upon its temperature. Warm air can hold more of it than cool air. At a particular temperature, when the air cannot hold any more vapour, the air is said to be *saturated.*

When the saturated air comes into contact with a cold body its temperature is lowered. As it cannot then hold all the vapour it held previously, some of the vapour condenses and becomes visible in various forms, such as dew, hoar-frost, fog, mist, rain, snow, and hail. This process whereby vapour becomes visible and takes a liquid form is called *Condensation.*

Dew. Evaporation is caused by the heat of the sun acting on the surface of water. Therefore the hotter the day is, the more active is the evaporation, and consequently the greater is the amount of water-vapour present in the atmosphere. At night the earth and all objects on it radiate or lose their heat, some more, some less. The air also grows cooler and cannot hold all the vapour it contained in the day-time. Some of the vapour is consequently deposited in the form of little drops of water on grass and other objects which are good radiators. These droplets of water are called *Dew*. When the temperature falls below zero (the freezing-point) the drops of dew are frozen. This frozen dew is called *Frost*. When the water-vapour freezes before it is formed into dew, it forms into *Hoar-frost*. As radiation is necessary for the formation of dew there is no dew in shady places or during cloudy nights.

Fog. In addition to oxygen, nitrogen, carbonic acid gas, and water-vapour the atmosphere also contains motes or small particles of dust. The presence of these dust particles will be evident if a ray of light is admitted to a room through a small hole. These particles of dust play a great part in the formation of fog and clouds. When the water vapour condenses on those particles which remain floating in the air near the surface of the earth, the result is called *Fog*. When the vapour is condensed at a greater height it is called a *Cloud*. *Mist* is the same as fog, except that it contains larger particles of moisture.

Rain. Clouds, which are nothing but tiny particles of water floating at a great height, being lighter than air, are carried hither and thither by winds. When they reach a cooler area or come in contact with some cold surface, further condensation takes place. The drops of moisture then become so heavy that they cannot be borne up by the air and so they fall as rain. They do not always reach the surface of the earth, for while falling they sometimes pass through a layer of dry unsaturated air and are wholly evaporated. If the temperature of the air is below freezing-point drops of moisture freeze and fall as *Snow*.

Rain-gauge. The rainfall of a place is measured by an instrument called a *Rain-gauge*. It consists of two parts: (*a*) a collecting can, and (*b*) a measuring glass. The collecting can A is placed in an upright-cylinder, open at the top and containing a funnel BCD which drains into the can below. Any rain which falls over the mouth of the cylinder runs down into the can and is there collected. At fixed intervals the water is emptied out and the amount measured in the graduated glass E. (See Fig. 40).

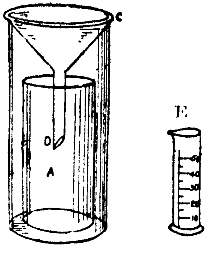


Fig. 40 —A Rain-Gauge.

When we say that the *Mean Annual Rainfall* of a place is so many inches we mean that, if all the rain that falls upon that particular place during a normal year be collected without the least amount being lost by evoporation or flowing away, the amount of water would cover the area to the depth of the number of inches indicated. Lines on a map joining places having the same mean rainfall, monthly or yearly, are called *Isohyets* (Greek *isos,* equal; *hyetos,* rain).

Temperature of the Atmosphere. The atmosphere is not heated by the rays of the sun directly. If the air is dry it allows the rays to pass through it to the earth without absorbing any of their heat. Thus the surface of the earth is first heated and then the layer of air which touches the earth's surface is heated. Then the heat passes to the layers lying next to the heated air, and so on until the whole atmosphere is heated. Thus the higher the layer is, the colder it will be: this is why mountains are colder than plains. On the other hand, if the air contains water-vapour, it absorbs some of the heat of the sun's rays when they pass through it and so becomes warm. This is how clouds are dispersed by the sun and the sky becomes clear.

The temperature of the atmosphere is measured by an instrument called a *Thermometer.* Thermometers are of many kinds, but the mercury thermometer is the most common. The difference between the highest and the lowest temperature of a place is called its *Range of Temperature.* The average of these readings is called its *Mean Temperature.* Places on the map having the same mean temperature, monthly or annual, are joined by lines called *Isotherms* (Greek *isos,* equal; *therme,* heat). Maps are drawn showing isotherms for January and July because these months, being the coldest and hottest months, show the greatest extremes of temperature.

Pressure of the Atmosphere. The pressure of air is due to its weight. That it has weight can be proved by first weighing a football full of air, and again when the air has been withdrawn. The air at the surface of the earth is much denser than that at a high latitude, because it has to bear all the weight of the air above it and is therefore under great pressure. The atmospheric pressure at the surface of the sea is 15 lbs. on each square inch. It varies with heat, height, and the amount of water-vapour present in the air. The greater the heat, the less is the pressure. As water-vapour is lighter than air, the presence of water-vapour in the air reduces the atmospheric pressure.

Barometer. The atmospheric pressure is measured by an instrument called a *Barometer* (Greek *baros*, weight; *metron,* measure). This instrument consists of a glass tube well over 30 inches in length. It is closed at one end and open at the other. It is filled with mercury and then inverted in a dish of the same liquid. It will be found that the column of mercury in the tube falls to a height of about 30 inches. The reason is that the pressure of the air on the mercury in the dish is sufficient to support a column of mercury about 30 inches high in the tube, so long as there is a vacuum above this column.

Places having the same mean atmospheric pressure are joined by lines on the map. Such lines are called *Isobars* (Compare them with isotherms and isohyets).

Distribution of Pressure. The distribution of atmospheric pressure on the surface of the earth is not uniform, but permanent differences of pressure exist on different parts of the earth. The sun is vertical over the equator twice during the year, *i.e.*, on March 21st and September 23rd, and almost vertical during the rest of the year. Thus near the equator the heat is the greatest and the pressure lowest. This region of great heat and low pressure is called the *Equatorial Belt of Calms* or *the Doldrums,* and extends approximately between 9 degrees N. and 1 degree S. There are two other belts of low pressure, one lying between 50 degrees N. and 60 degrees N., and the other.

roughly, along the Antarctic Circle or 60 degrees S. They are due to the rotation of the earth. As the earth rotates, the atmosphere also rotates with it,—in the northern hemisphere round the North Pole, and in the southern hemisphere round the South Pole. One result is that the air tends to whirl away from the poles and to heap up towards the equator, just like water in a basin when it is stirred with a stick. This whirling away of the air from the polar regions leaves less air approximately between latitudes 50 degrees and 65 degrees both north and south of the equator, and thus causes those areas of low pressure.

In addition to these three belts of low pressure, there are two belts of high pressure. They lie roughly along latitudes 35 degrees N. and 30 degrees S. and are respectively known as *Calms of Cancer* and *Calms of Capricorn.* The heated air of the hot equatorial belt of low pressure rises high, and reaching the upper regions of the atmosphere it becomes cool and heavy and blows towards the poles, getting lower and lower at the same time. At latitudes 35 degrees N. and 30 degrees S. it meets the conflicting current of air coming from the poles towards the equator, with the result that the air is heaped up there. These latitudes consequently become areas of high pressure. (See Fig. 41).

Movement of the Atmosphere. Air in motion is called *wind.* Winds are caused by the difference of atmospheric pressure at various places on the surface of the earth. They blow from areas of high pressure to those of low pressure. The air coming in contact with a heated surface is also heated. This heated air expands, becoming less dense or lighter. Thus an area of low pressure is created, and the lighter air rises. To take its place the air from regions of high pressure

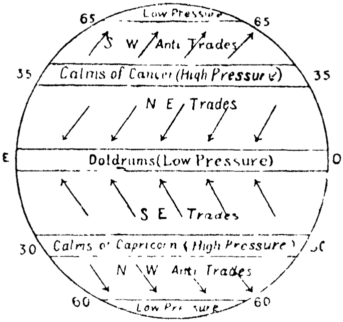


Fig. 41. Distribution of Pressure and Permanent Winds.

flows in. This also in its turn is warmed, expands, becomes lighter, and rises. Thus a current of air flowing from one part of the earth's surface to another, or a wind, is produced.

Kinds of Winds. Winds, like currents, are of three kinds, *viz.*, permanent, periodical, and variable. Permanent winds are caused by permanent differences of pressure; periodical winds are caused by differences of pressure at definite intervals; and variable winds are caused by differences of pressure resulting from local peculiarities and special conditions.

Permanent Winds. The most important permanent winds are the Trade Winds and the Anti-trade Winds or the Westerlies. 'Trade' means 'tread' = path.

Trade-Winds and Anti-Trade Winds. *How they are caused.* From the distribution of pressure on the surface of the earth given above it is clear that in both the northern and the southern hemispheres a belt of high pressure lies between two belts of low pressure. As winds blow from areas of high pressure to those of low pressure, so from each of these two belts of high pressure two sets of winds will blow to those of low pressure—one towards the equator and the other towards the poles. The winds that blow towards the equator are called *Trade-winds,* while those that blow in the opposite direction towards the poles are called *Anti-trade winds*, or simply *Anti-trades.*

Their Direction. If the earth were stationary, these trade-winds would have blown from due north to due south in the northern hemisphere, and from due south to due north in the southern hemisphere. But the earth rotates from west to east with much greater velocity at the equator than at the poles. These winds coming as they do from latitude 35 degrees N. and 30 degrees S. towards the equator, that is, from places having less velocity to those having greater velocity, are, according to *Ferrel's Law* (already explained in chapter VII) left behind and become *north-east* and *south-east* winds, according as they are north or south of the equator.

Similarly, the anti-trade winds which blow polewards, *i.e.*, from places having greater velocity to those having less velocity, gain on the earth's rotation and become *south-west* and *north-west*, according as they are in the northern or the southern hemisphere. As their direction is westwards they are also called "Westerlies."

Their Range. The limits of latitude within which these winds blow are not fixed, but follow the course of the sun. As the sun goes above the equator towards the Tropic of Cancer, these limits shift further towards the north pole in the northern hemisphere and towards the equator in the southern hemisphere, and *vice versa* as the sun goes below the equator towards the Tropic of Capricorn. On an average, the trade-winds blow between 35 degrees N. and 9 degrees N. and also between 30 degrees

S. and 1 degree S., while the anti-trades blow between 35 degrees and 65 degrees N. and also between 30 degrees and 60 degrees S.

Some Notable Conclusions. (1) As the trade-winds blow from the north-east and the south-east they first strike the eastern side of the countries to which they blow. Therefore whatever moisture they bring with them is given to the eastern side. Thus within the tropics the eastern portions are rainy, while the western portions are dry. Rajputana, Arabia, the Sahra, the California Desert in the northern hemisphere, and the West Australian Plateau, the Kalahari Desert, Peru, and Northern Chile in the southern hemisphere, are all dry places because they are situated on the western side. On the other hand, East China, Indo-China, Abyssinia, the south-east coast of the United States, the east coast of Central America, the north-east coast of S. America in the northern hemisphere, and eastern Australia, Natal, and eastern Brazil in the southern hemisphere receive sufficient rainfall because they are situated on the eastern side.

(2) Outside the tropics where the "Westerlies" blow, the western coasts are rainier than the eastern ones. The west of Europe, of Canada, and of the United States in the northern hemisphere, and of New Zealand and southern Chile in the southern hemisphere; have a heavier rainfall than the eastern parts.

(3) In the Equatorial Belt of Calms on account of high temperature the air is always rising. On reaching the upper regions of the atmosphere it is cooled and most of its water-vapour is condensed and falls as rain. Great heat and heavy rainfall and consequently luxuriant vegetation are the characteristics of this zone. The East Indies, the Congo basin, and the Amazon basin are regions of heaviest rainfall because they lie within this

belt. The two large rivers, the Congo and the Amazon, owe their large body of water to this heavy rainfall.

(4) In the Calms of Cancer and Capricorn, which are the regions of high pressure, the air is always descending. As it comes from the cool upper regions to the hot lower regions, there can be no condensation through increase of temperature. Consequently there is no rainfall. Therefore in or near these belts lie most of the dry deserts of the world. The deserts of Rajputana, Persia, Arabia, and California, as well as the Sahra, lie in the Calms of Cancer. The deserts of Australia, Kalahari, and Atacama (Chile) are situated in the Calms of Capricorn.

(5) The sun is vertical at the equator on March 21st and September 23rd. On these two dates the equator is therefore the hottest line on the earth. During the rest of the year the hottest line will be north or south of the equator, as the sun's rays are vertical towards the Tropic of Cancer or the Tropic of Capricorn. This line of greatest heat resulting from the vertical rays of the sun is called the *Heat Equator* or *Thermal Equator*.

2. **Periodical Winds.** The chief periodical winds are the Land and Sea Breezes and the Monsoons. The former blow for short periods, while the latter blow from season to season.

Land and Sea Breezes. During the day the land is heated more rapidly than the sea. The air over the land is therefore hotter than the air over the sea. The atmospheric pressure is therefore lower on the land than on the sea. Consequently the cooler and heavier air from the sea blows towards the land as a sea breeze. It blows from the forenoon till sunset.

During the night the land is cooled more rapidly than the sea. The air over the land is therefore cooler and heavier than that over the sea and therefore blows towards the sea as a land breeze. It blows from nightfall to early morning.

Monsoons. Monsoons, or the seasonal winds, are those periodical winds which blow for about six months in one direction, *i.e.*, from the sea to the land, and for other six months in the other direction, *viz.*, from the land to the sea. During summer, *i.e.*, in the months of May, June, July, and August, the sun is vertical towards the Tropic of Cancer and therefore the heat equator, or the line of greatest heat, shifts northwards, *i.e.*, over Mexico, Northern Africa, and Southern Asia. These land regions, especially the plains of northern India, Indo-China, and China, receive more of the sun's heat and have a lower atmospheric pressure than the waters of the Indian and Pacific Oceans situated near them. Thus the cooler and heavier air of these oceans blows towards the heated plains. The north-east trades which would otherwise blow over the Indian Ocean are totally overcome; the south-east trades are drawn across the equator, and by the decreased rate of rotation are deflected to the right and blow over India from May to September as the *South-West* or *Summer Monsoon.* (Fig. 42). In China and Indo-China this wind blows as the *South-East Monsoon.* As it comes

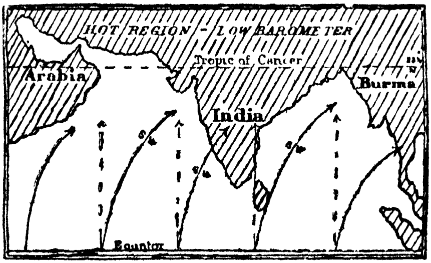


Fig 42 The S W. Monsoon.

from the ocean, this monsoon gives plenty of rainfall to India, China, and Indo-China.

During winter, *i.e.*, in the months of November, December, January, and February, the sun is vertical towards the Tropic of Capricorn and the conditions are therefore reversed. North Australia becomes a centre of high temperature and consequently low pressure, while the plains of India and China become very cold and have high pressure. The north-east trades are drawn southwards towards the equator, and blow over India from November to April as a *North-East* or *Winter Monsoon.* (Fig. 43). Over China and North Australia it blows as a *North-West Monsoon.* As it comes from the cold, dry land this monsoon is cold and dry. In the case of North Australia it gives considerable rainfall, as it passes over a large expanse of water. The section of it which crosses the Bay of Bengal picks up some moisture, which falls as rain on the east coast of India and Ceylon. Monsoons also occur on the Guinea coast of Africa, Madagascar, Natal, Brazil, Central America, the south-east coast of North America, and Spain, but are not as important as the monsoons of

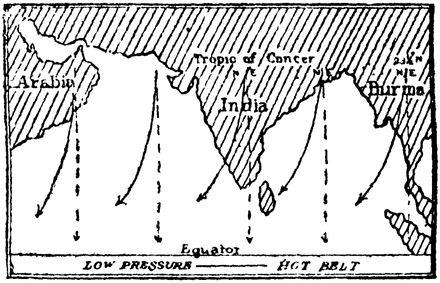


Fig. 43. -The N. E Monsoon

India, China, Indo-China, and Australia.

3. **Variable Winds.** These include cyclones, anti-cyclones and all local and miscellaneous winds as, for instance, the Simoom or hot wind of Arabia, the Sirocco or hot wind of the interior of Africa, the typhoons or circular storms in the China seas, and the hurricanes or cyclonic storms in the West Indies.

Cyclones. Sometimes a small portion of the earth's surface becomes heated more than the surrounding parts. Thus a limited area of low pressure surrounded by one of high pressure is created. The cooler and heavier air from outside flows in towards the centre with a whirling motion and forms a *Cyclone* (see Fig. 44).

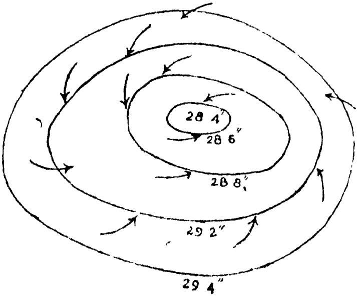


Fig. 44—Cyclone.

When south of the equator this circular motion is clockwise, and when north of the equator it is anti-clockwise. In addition to this motion, the entire cyclone also moves in the curve of a parabola (see Fig. 45). The centre of a cyclone is generally calm. As the central air rises, it cools; the water vapour is condensed and falls as rain. Hence it is that cyclones are always accompanied by rain. Most of the winter rain of the Punjab

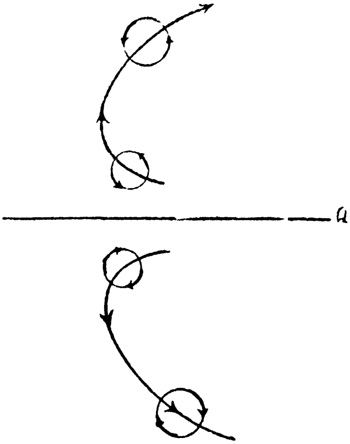


Fig 45.—Path of Cyclone.

is due to cyclones rising from the Arabian Sea and the Persian Gulf.

Anti-cyclones. In anti-cyclones, on the other hand, the high-pressure area is surrounded by a low-pressure area. Therefore the winds blow spirally from inside to outside, and their rotation is in the opposite direction to that of the cyclones (see Fig. 46). Generally they are

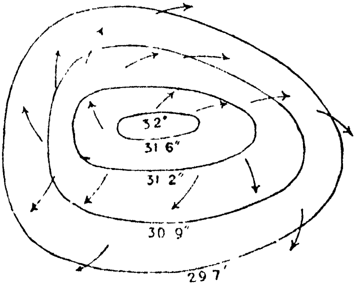


Fig. 46 —Anti-Cyclone.

formed by the meeting of high-pressure areas of two successive cyclones. Hence it is that the cyclone is followed by the anti-cyclone.

As the air of the inner high-pressure area settles down, it is compressed and thereby increases the pressure. This increase of pressure leads to increase of temperature and consequently no condensation takes place. Therefore an anti-cyclone is not a storm, but an area of fine and dry weather.

Exercises.

1. What is meant by the atmosphere? What is it composed of? How high does it extend?

2. Explain the phenomena which result from the presence of water-vapour in the air.

3. How is the atmosphere heated? Why do we feel colder as we go up? What is the effect of water-vapour on the temperature of the atmosphere?

4. What is atmospheric pressure? How is it measured? In what way do heat, elevation, and water-vapour affect it?

6. What are trade winds and anti-trade winds? How are they caused? In what latitudes do they blow?

5. What do you understand by the distribution of pressure? Show the connection between the permanent winds and the distribution of pressure.

7. Describe, and illustrate by a diagram, the belts of constant winds and calms on the earth's surface.

8. Explain how the rotation of the earth affects the direction of the permanent winds.

9. "The countries situated within the tropics have their eastern portions wetter, while those lying outside the tropics have their western parts moister." Account

for this and give examples.

10. How is it that most of the deserts of the world lie in or near the Calms of Cancer and Capricorn? Give instances.

11. What are monsoons? How are they caused? Over what countries and at what seasons do they blow?

12. Write notes on—

Mean temperature, range of temperature, isotherms, isobars, isohyets, cyclones, anti-cyclones, land and sea breezes, typhoons, evaporation and condensation, heat equator, rain-gauge.

CHAPTER X.

CLIMATE AND ITS INFLUENCE.

What Climate is. By climate is meant the general circumstances of a place as regards its temperature, the character of the prevailing winds, moisture, and other atmospheric conditions. Briefly, it is generalised weather. Weather is the condition of the atmosphere at a particular time; climate is the average condition of the weather for a long time and over a large area. A climate is said to be good when it is favourable to man, contributing to the full development of his powers, the prolongation of his life, and the fertility of the land upon which he lives. On the contrary, a climate is said to be bad when it affects man adversely.

Factors of Climate. The chief causes which determine the climate of any place are the following.—

1. *Latitude or Distance from the Equator.* The sun is more or less nearly vertical over the equator throughout the year. Other things being equal, the nearer a place is to the equator, the hotter it will therefore be. For example, Madras and Bangalore are hotter than Calcutta and Bombay.

2. *Altitude or Elevation.* On the whole, the higher a place lies, the colder it will be. This is due to the fact that the upper layers of air are thinner. They can therefore not only absorb less heat than the lower layers, but also radiate it more quickly at night. Moreover, air is not heated directly by the rays of the sun, but by the heat radiated by the earth. The upper layers, being further

away from the source of heat, are colder than the lower ones. This is why mountains are colder than plains and the roof of the house is cooler than the ground-floor. Simla and Murree are colder than Delhi and Lahore.

3. *Distance from the Sea.* As water is both heated and cooled more slowly than land, the sea is cooler in summer and warmer in winter than the land. The winds from the sea consequently make the coastal places cooler in summer and warmer in winter than they would otherwise be. Hence the nearer a place is to the sea, the more equable its climate will tend to be. Bombay and Colombo, being on the sea coast, are neither hot in summer nor cold in winter, while Multan and Peshawar, being farther inland, are very hot in summer and very cold in winter.

4. *Prevailing Winds.* If the winds come from the sea, the climate is equable and moist. If they come from the land, they are dry, and are therefore hotter in summer and colder in winter. In India the north-east monsoons come from the land; they are therefore dry and make the climate colder. But the south-west monsoons come from the sea and so bring copious rains and make the climate moist.

5. *Direction of Mountains.* If the mountains run in the same direction as the prevailing winds, the latter pass on without being checked. The Aravalli hills in Rajputana run from north-east to south-west, in the same direction as the south-west monsoons. Accordingly these monsoons blow on unchecked to the Siwalik hills without shedding a drop of rain in Rajputana. On the other hand, if the mountains run at right-angles to the prevailing winds, they check these winds and cause rain. The Himalayas intercept the cold winds of the north and thus protect the Indo-Gangetic plain from their benumbing effect.

Where the mountains check the warm and moist winds, they are rainy on the windward side and dry on the leeward side. The Western Ghats check the south-west monsoons laden with moisture, and cause heavy rainfall on the Bombay side and practically no rain on the Deccan side. Similarly the southern slopes of the Himalayas have 80 inches of annual rainfall in some places, while the northern slopes have only 30 inches.

6. *Amount of Rainfall.* Rainfall may be due either to radiation or to relief. *Radiation rainfall* is always caused by the cooling of air containing moisture. When a current of damp air rises into the upper and cooler regions of the atmosphere it is cooled not only by its passing into colder regions, but also by its expansion owing to the diminished pressure in the higher layers. Thus places situated in the equatorial belt of low pressure, where the air is always ascending on account of the great heat, have very heavy rainfall.

Relief rainfall is caused by the mountain ranges which lie in the path of the moisture-bearing winds and force these winds to rise in order to cross the barrier. In rising high they cool and relieve themselves of their moisture. The higher and steeper the barrier is, the heavier is the rainfall, and consequently the more moist is the climate. The climate of Bombay is much more moist than that of Karachi.

7. *Ocean Currents.* Warm currents give a warmer climate to the places near which they pass; cold currents have the opposite effect. The British Isles enjoy an almost equable climate throughout the year on account of the influence of the warm Gulf Stream Drift, while other countries in the same latitude experience extremes of heat and cold. Similarly the Kuro Siwo current warms the eastern shores of Japan and the west coast of North

America. On the contrary, the cold Benguela and Labrador currents make the climates of the west coast of South Africa and the east coast of North America respectively much colder than they would otherwise have been

8. *Slope of the Land.* In the northern hemisphere the southern slopes of a mountain receive the rays of the sun more nearly vertically and are consequently much warmer than northern slopes. In the southern hemisphere the reverse is the case. Thus the best grapes ripen on the southern slopes of Algeria, and on the northern slopes of the Cape of Good Hope. Similarly Siberia on account of its slope towards the north, that is, away from the sun, is colder than it would otherwise be.

9. *Nature of the Soil.* Sandy soil is much more rapidly heated and cooled than damp clayey soil. Sindh, with its sandy soil, is therefore much hotter during the day and much colder during the night than Bengal in the same latitude, owing to the latter's damp clayey soil. Similarly the range of day and night temperature of Multan is much greater than that of Ambala in the same latitude.

10. *Vegetation.* Trees have a great effect on rainfall and consequently on climate. They produce a coolness in the air around them and thus help in condensing the water-vapour present therein. The forest areas of the world are regions of very heavy rainfall. The Congo basin in Africa and the Amazon basin in South America have dense forests and consequently very heavy rainfall. India, which was once well covered with forest, is said to have now a much drier climate than it formerly had. Famines due to lack of sufficient rain would therefore be more frequent now than they were in the past, were preventive measures not adopted. For this reason the Government of India now takes great care of the

forests of India. Instances are not wanting where large areas which were once well watered have been rendered almost rainless by the destruction of the forests.

Factors of Rainfall. From the above it will be clear that temperature and rainfall are the chief constituents of climate. The circumstances which determine the rainfall of a place may be summed up as below:—

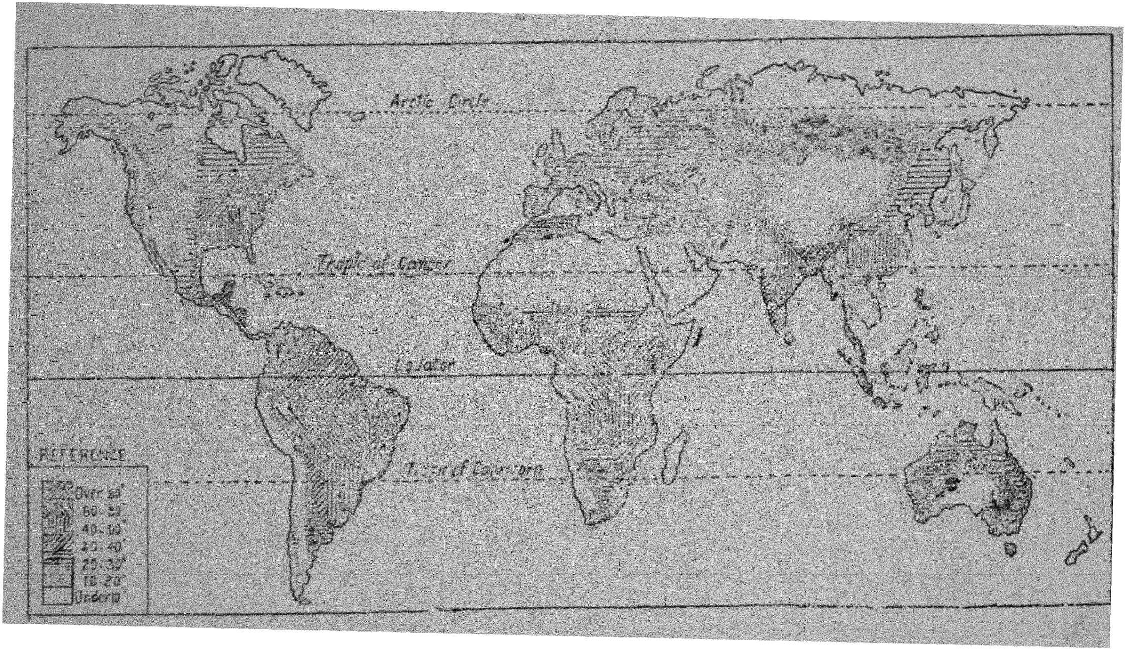
(*a*) *Situation.* If a place is situated where the air is ascending and the evaporation is great on account of great heat, as in the Doldrums, the rainfall will be heavy. Where the cold is great and the evaporation is absent, as in the Tundras or cold regions along the Arctic Sea, there is no rainfall.

(*b*) *Nearness to the Sea.* As the air coming from the sea brings moisture with it, places near the sea have generally more rainfall than those situated farther away. Madras is wetter than Mysore.

(*c*) *Prevailing Winds.* If the prevailing winds are warm and moist they bring more or less rain; and if they are cold and dry they bring no rain. Bombay, which is under the influence of the warm moist south-west monsoons, has a heavier rainfall than Peshawar, which is subject to the cold winds of Central Asia.

(*d*) *Direction of Mountains.* If the mountains run in the same direction as the prevailing winds, there is no rainfall; but if they lie at right angles to the winds they check the winds and bring about a rainfall. The Satpuras and the Vindhaya Mountains run east and west, that is, in the same direction as the Arabian Sea monsoons. They therefore allow the monsoons to pass on and so get no rainfall; while the Western Ghats which meet the monsoons at right angles have heavy rains.

(*e*) *Currents.* Warm currents increase rainfall, while cold currents decrease it. The eastern coast of



Map of the world showing Annual Rainfall

South Africa, along which the warm Mozambique and Agulhas currents pass, receives more rain than the western coast, near which the cold Benguela current flows.

(*f*) *Vegetation.* We have shown in a previous paragraph how greatly trees and forests affect rainfall.

Distribution of Rainfall. Taking into consideration the above factors of rainfall we can easily discover whether the rainfall of certain areas is likely to be abundant or scanty.

Regions of Heavy Rainfall.

(1) The places that are situated in the Doldrums or the Equatorial Belt of high temperature, low pressure, and ascending air. The East Indies, the Congo basin and the Amazon basin are comprised in this region.

(2) The regions where the moisture-bearing winds blow. They are the Western Ghats, the Himalayas, and the Khasi, Garo and Jantia hills of Assam, where the south-west monsoons blow; Japan, East China, and Indo-China, where the north-east monsoons blow; north-east Australia, south-east Africa, the Brazilian coast of South America, and Florida in North America, where the trade-winds blow; New Zealand, Cape Colony, Southern Chile, the west coasts of North America and Europe, where the westerly winds blow. It is worthy of note that at Cherrapunji on the Khasi hills of Assam the annual rainfall is about 500 inches, the heaviest in the world.

Regions of Scanty Rainfall:—

(1). The places that are situated in the Calms of Cancer and Capricorn. Here, on account of high pressure the air is always descending from cooler regions to warmer regions and therefore no rain falls. Rajputana, Persia, Arabia, the Sahra and California in the Calms of Cancer; and the Australian, Kalahari and Atacama deserts in the Calms of Capricorn, are the notable examples.

(2). The regions that are situated (*a*) on the leeward side of mountains, or (*b*) in the interior of continents beyond the reach of the moisture-bearing winds. The chief examples of the former case (*a*) are the Deccan, situated on the leeward side of the Western Ghats; Tibet, sheltered by the Himalayas; and the Great Basin of the United States, protected by the Rocky Mountains, Gobi and Turkistan, situated in the heart of Asia, are instances of the latter case (*b*).

Types of Climate and Climatic Regions. Before giving a brief description of the chief types of climate distributed over the surface of the earth, we must remember that climate changes gradually from one type to another, and so no exact limit can be fixed between one type and its neighbour. Many regions have climates intermediate between the types that are described below:—

1. *Equatorial Climate.* Although the equatorial belt of high temperature, low pressure, ascending air, and heavy rainfall moves northward and southward with the sun, certain regions on either side of the equator always lie within it. Such are the Malaya Archipelago and the basins of the Amazon and the Congo. Here the temperature is very high and the annual range of temperature between the hottest and the coldest months is very small. The rain is constant and heavy and there is no dry season.

2. *Sub-equatorial* or *Tropical Climate.* The regions in which this type of climate occurs lie on both sides of those where the equatorial type prevails. Owing to their greater distance from the equator these regions are within the belt of equatorial rainfall for one part of the year and outside it for another. They have therefore sufficient rainfall in their summer, when the heat is very great. For the remaining part of the year, when the heat is less, the season is rather dry. Thus there are

two seasons, the wet and the dry. The temperature is high throughout the year. This type of climate prevails in the Deccan, the Sudan, Nigeria, Guinea and Venezuela in the northern hemisphere, and in the Zambezi valley, southern Brazil, Paraguay, and Uruguay in the southern hemisphere.

3. *Monsoon Climate.* This type of climate is very similar to the tropical type and prevails in those tropical regions where the monsoons blow. The summers are hot and rainy, but the winters are comparatively dry. Owing to the great area within which the monsoons occur, several sub-types exist. Bombay, which has a high mean temperature, low range, and heavy rainfall; Canton, which has a lower mean temperature, greater range, and a moderate rainfall; and Pekin, which has hot summers and very cold winters, are the principal examples of the sub-types. The regions of monsoon climate are India, Indo-China, China, Japan, Natal, north-eastern Australia, and the south-eastern portion of the United States.

4. *Hot Desert Climate.* This type of climate is found in the regions lying in or near the. Calms of Cancer and Capricorn belts of high pressure, and in the interior of continents beyond the reach of moisture-bearing winds. The principal examples are the deserts of Rajputana, Persia, Arabia, Gobi, the Sahra, and California in the northern hemisphere, and the Australian, Kalahari and the Atacama deserts in the southern hemisphere. Here the climate is hot and dry. The days are extremely hot and the nights extremely cold. The annual and the diurnal ranges of temperature are great.

5. *Mediterranean Climate.* Owing to the movement with the sun of the various belts of high and low pressure, certain regions approximately in latitude 28 degrees to 40 degrees in both hemispheres come within the range

of the trade-winds in summer and of the "Westerlies" in winter. The trade-winds coming from the cold and dry places do not bring any rain, but the "Westerlies" coming from the ocean bring plenty of rain to the western coasts. Thus summers are hot and dry and winters are mild and rainy. As this type occurs extensively in areas around the Mediterranean Sea, it is known by the name of *Mediterranean* climate. It prevails in southern Europe, Northern Africa, California, Central Chile, Cape Colony, and South Australia.

6. *Temperate Climate.* This type of climate occurs in higher latitudes than the Mediterranean lands. temperate regions have cooler summers and colder winters than the Mediterranean regions. There are two sub-types of this climate: (*a*) the warm temperate, in which the mean annual temperature does not fall below 50 degrees F., and (*b*) the cold temperate, in which the mean annual temperature is below 45 degrees F. On the western coast of the regions of both types the "Westerlies" which come from the ocean are the prevailing winds. Here the summers are cool and the winters mild, and the rainfall is uniformly distributed throughout the year. Such a climate is called an *Oceanic* or *Maritime* climate and is found in western Europe, British Columbia, southern Chile and Tasmania. In the interior of these regions the summers are hot, the winters severe, and the rainfall, which falls chiefly in summer, is low. Such a climate is called a *Continental* climate and occurs in Siberia, central Canada, and the central United States. In the coastal regions to the east of these continental regions a moderated continental climate is found. Owing to their nearness to the sea such regions receive a heavier rainfall and snowfall, due chiefly to cyclones. As the winds blow from the land to the sea, and cold Labrador and Kurile currents

flow along the shores, the winters are very severe. Such a climate is found in eastern Canada and in Manchuria.

7. *Tundra or Cold Desert Climate.* This type of climate occurs in the regions lying along the Arctic Ocean and called the Tundras. The northern parts of these regions remain frozen throughout the year and the southern parts are intensely cold. Even in summer it is never warm and the winters are bitterly cold. Their mean annual temperatures are the lowest known.

8. *Mountain Climate.* The climate of the mountains differs from that of the plains in all parts of the world. On account of the great elevation the temperature and the pressure of the air are lower, and generally a more abundant rainfall occurs. Very high mountain regions, especially near the Equator, have many varieties of climate in succession, from the hot moist equatorial type down to the Tundra type. Quito in South America, though situated on the equator, enjoys a mild climate simply on account of its elevation.

Local Variations of Climate. In addition to the climatic types named above, there is an infinite variety of climates due to local conditions. Most of these local variations are caused by mountains. Thus in Turkistan there is in winter a warm south-west wind blowing above the cold north-easterly winds from Siberia; the temperature therefore increases upwards, and the inhabitants climb the hills when the cold in the plains becomes unbearable. Lakes also have a local effect, as in the case of the moderating influence of Lake Baikal. Even the smoke and fires of large towns and the reflection of the sun's rays from walls help to raise the temperature above that of the surrounding country.

Influence of Climate. No single geographical factor exercises a greater influence on the economic development of a country than does climate. It closely concerns the daily life of man—his food, clothing, dwelling, occupations, industries, commerce, and physical and mental characteristics.

Its two most important constituents, *viz.,* moisture and warmth, are primary essentials to the vegetable and animal life upon which human existence depends. How different climates affect differently the life and activity of man is shown briefly, though perhaps too strongly, in the following words:—

"In the *arctics* you get nothing for something, in the *tropics* something for nothing, while in the *temperate regions* you get something for something."

Let us take these three principal climatic regions separately:—

(*a*) *Arctic Region.* In this region on account of the excessive cold food is very scarce. The hunting of the reindeer and the polar bear is the only occupation of the few inhabitants. Clothing and shelter, however simple, cannot be easily procured. With all their efforts and their cleverness these people lead a hard life. Leisure is essential to all progress. Where it takes men all their time to earn a bare living, there is not much room for improvement. As their hard conditions of life leave them no leisure, these people are very low in the scale of civilisation.

(*b*) *Tropical Region.* Here, on account of the great heat and moisture, food is produced in abundance. Moreover, as the same quantity of food can support more people in warm than in cold climates, less food and clothing are required here. Life in such regions is therefore very easy and there is little to compel men to be active, industrious, and enterprising. They are for the most part content if they have food enough for the day.

Their wants are simple and easily satisfied and provide no spur to ambition.

(*c*) *Temperate Region.* In this region man cannot live without effort. Life here is neither so hard that man has no chance, nor yet so easy that he has no stimulus to work. The climate does not, like that of the tropics, weaken him and make him indolent, nor does it, like the arctic climate, put such a strain upon him that he has no time and strength left after securing his bare living. Moreover, it has been proved that the changes of the seasons and even the changes of weather from day to day in temperate regions are invigorating both to body and mind. The dwellers in temperate regions are therefore on the whole active, energetic, and industrious. As all human progress depends upon activity of mind and body, these people are far advanced in science and art and thus tend to dominate the world.

Exercises.

1. What do you understand by the term climate? Differentiate it from weather.

2. What are the chief causes upon which the climate of a place depends? Explain them and give examples.

3. Name the chief factors that determine the rainfall of a place. Give examples in each case.

4. State which regions of the world have a heavy rainfall and which a scanty rainfall. Give reasons and instances.

5. Name and describe the chief types of climate distributed over the surface of the earth.

6. Characterise the climate of a mountain from top to bottom.

7. Show the effects on the climate of a country of

(*a*) elevation, (*b*) direction of the winds, and (*c*) vegetation.

8. Describe fully the differences between a maritime and a continental climate. State the causes of the differences and give an example of each kind of climate.

9. What are the characteristics of a *Mediterranean climate?* In what parts of the world is it met with?

10. How does climate affect the life and activity of man ? Explain and give illustrations.

PART II—ECONOMIC GEOGRAPHY.

CHAPTER XI.

VEGETATION, NATURAL AND CULTIVATED.

Natural Vegetation. The distribution of vegetation over the surface of the earth is determined by the nature of the climate, that is, heat and moisture, and by the character of the soil. Of these, moisture is the first requisite of plant life and determines the type of vegetation. Plants that grow in regions where abundant moisture is available for their growth, have broad and thin leaves to get rid of the excess moisture. In dry regions such plants grow as can resist strong evaporation. They have leaves that are thick, leathery, and needle-shaped, or lie parallel to the rays of the sun. Their roots are long and bulbous, to draw and store water from great depths.

Vegetation Zones. As vegetation mainly depends upon climate, the vegetation zones correspond closely to the climatic regions. The most important vegetation zones are the following:—

1. *Equatorial Zone.* As both heat and moisture are great all the year round, vegetation is very luxuriant. Besides evergreen giant trees having huge straight trunks, there is a dense undergrowth which makes the forest almost impenetrable except by means of rivers. The foliage is so thick that the rays of the sun can hardly penetrate it and therefore darkness prevails even at noon. The most important economic trees and plants are rubber,

gutta-percha, mahogany, sandalwood, logwood, bamboo, banana, cinchona, and various kinds of palms. The basins of the Congo and the Amazon, and the Malay Peninsula and Archipelago are included in this zone. Forests growing in the basin of the Amazon are called Selvas. Where these forests have been cleared rice, arrowroot, sugar, coffee, cacao, tobacco, cloves, nutmeg, and ginger are cultivated.

2. *Tropical Zone.* Here the chief vegetation is the tall grasses of the *Savannahs* or grassy plains. The Savannahs are found in Brazil, Mexico, Central America, Venezuela, the Guianas, the Sudan, East Africa, parts of the Deccan and the hinterland of northern Australia. The Savannahs of Venezuela are called *Llanos;* those of Brazil *Campos;* and those of Australia the *Downs.* They become dry and bare during the dry season, but as soon as the rainy season begins, they spring to life and show a green appearance. As there is a long dry season, the trees are drought-resisting and capable of storing water. The most common are the baobab, acacia, eucalyptus, and tamarind. The chief economic products are gums and resins from the acacia, and eucalyptus oil.

3. *Monsoon Zone.* This region includes India, Burma, Indo-China, Northern Australia, the shores of the Gulf of Mexico, and the Caribbean Sea.

One well-marked dry season is followed by an abundant rainfall in summer and hot climate throughout. Such trees exist here as teak, sal, mahogany, logwood, ebony, and palm. As rainfall is not continuous throughout the year, monsoon forests are more open and more easily cultivated than the equatorial forests. On the rich plains maize, rice, sugar, banana, cotton, indigo, and jute are cultivated.

4. *Desert Zone.* As there is no rainfall here the vegetation is very scanty. The plants found here and there have thick bark to resist evaporation, or long bulbous roots to draw and store water from some depth. Their leaves are often thorny or they droop parallel to the rays of the sun. Gum-acacia is the typical tree. Where moisture is available date palms and millets are cultivated. Such fertile spots in deserts are called *Oases.* The zone includes the Sahra; the deserts of Arabia, Persia, Thar and Gobi; portions of California, Mexico, Peru, Chile; and the Kalahari and Australian deserts.

5. *Mediterranean Zone.* This region has hot dry summers and mild moist winters and includes lands bordering the Mediterranean Sea, the south-west of South Africa, south-western Australia, and central Chile. Here plant growth is slow, but continuous throughout the year. Trees are of low stature and have small leaves, prickly thorns, resins, and essential oils for conserving moisture. The sunny summers and mild winters greatly favour the growth of fruits, such as grapes, lemons, oranges, plums, apricots, pomegranates, figs, pears, peaches, and apricots.

6. *Temperate Zone.* This zone includes three types of vegetation, *viz.,* scrublands, grasslands, and forests. The scrublands are found in parts of Australia, California, and the Great Basin of the United States; on the high plateaus of Asia Minor; and in Patagonia: in these places drier conditions prevail than in the Mediterranean lands. Grasslands include the pampas of Argentine, the prairies of Canada and the United States, the steppes of Russia, the veldt of South Africa, the pusztas of Hungary, and parts of Bulgaria, Rumania, Italy, and Spain. The warmer parts of this zone grow broad-leaved deciduous forest trees, such as oak, elm, walnut, ash, maple, chestnut,

beech, and poplar. In the dry season these trees shed their leaves and become bare. In the colder parts of North America and Eurasia grow coniferous trees, such as pine, spruce, larch, and fir. To resist the cold of this region these trees have thick, short, evergreen, needle-shaped leaves. These forests supply very useful timber. In the southern hemisphere such trees are found in Chile, New Zealand, and New Caledonia.

7. *Tundra Zone.* North of the coniferous forests stretch the tundras. On account of the excessive cold the land remains frozen for the greater part of the year, and nothing grows except ferns, mosses, lichens and a few short-lived flowering plants, such as forget-me-not and the Arctic poppy, in summer when the snow melts.

8. *Mountain Zone.* The equatorial mountains that reach the snow-line bear all the types of vegetation that are found from the equator to the poles. The lower slopes, being rainier and warmer, are covered with dense forests like those found in the equatorial zone. Next are found broad-leaved forests of the temperate zone, gradually giving place to coniferous trees. At still higher levels the trees become dwarfed and gradually disappear.

Cultivated Vegetation. Many economic plants are now cultivated in regions to which they do not originally belong; they have adapted themselves to the climate and soil of new localities, *e.g.*, maize, tobacco, potato, and numerous fruits. The most important plants of economic value are the following:—

Wheat. Wheat, the most valuable of all bread plants, does not flourish in very hot or very cold regions. It needs a cool and moist period for its early growth, and bright, dry, warm weather for its ripening. The soil should be loamy, that is, neither too sandy nor too clayey. Such conditions are best met with in temperate latitudes.

Therefore wheat is largely grown in the prairies of the United States, the plains of Canada, the pampas of Argentina, the black-soil of southern Russia, the cooler regions of northern India, France, Siberia, and the pusztas of Hungary.

Maize. Maize requires a hot and moist growing season and a warm, dry ripening period. To provide moisture for its growth the rainfall should be moderate, not heavy and continuous; it needs a moist but well-drained soil. It is mostly grown in the United States, Argentina, Rumania, Hungary, Italy, India, Mexico, Brazil, South Africa, and East Australia. In the United States, which produce three fourths of the world's supply, it is known as "Indian corn" and is largely used for rearing and fattening live-stock. In Hungary and South Africa respectively maize is known as Turkish wheat and "mealies."

Oats. Oats require a cooler and moister climate than wheat or maize. They are chiefly used as a food for horses, but in Scotland, Denmark, and Scandinavia they form a large part of the food of the people. Other countries producing oats are Russia, Sweden, Germany, Canada, Hungary and New Zealand. Europe produces two-thirds of the world's supply of oats.

Rye. Rye requires less heat than wheat, and can flourish in almost any soil, however poor it may be. It is produced extensively in Scandinavia, Holland, Northern Germany, and Central Russia. The black bread made from it is one of the principal articles of food in these countries.

Barley. Barley is the hardiest of all the cereals. It requires almost the same climate as wheat, but it has a wider range of climate than any other cereal. It is chiefly cultivated for making malt. The principal barley-growing countries are Russia, the United States, Germany, Rumania, India, France, Italy, and Turkey. Of all grain-crops it is the one that grows farthest north in latitude, and highest up on mountain sides.

Rice. Rice requires a great deal of heat and moisture. It grows best " with its feet in the water and its head in the sun." Thus the swampy river deltas of tropical and sub-tropical south-eastern Asia are best suited for it. It is extensively produced in India, Burma, Cochin-China, Siam, China, Japan, the Malay Peninsula, the East Indies, and the lower valleys of the Amazon, the Mississippi, the Nile, and the Niger. Rice is the chief food product of countries situated in the south-east of Asia, and it is to these countries what rye is to northern Europe.

Potatoes. Potatoes, an important article of European diet, are the staple food of the people of Ireland and eastern Germany. They are also used in the production of starch and alcohol. The potato-plant is well adapted for regions where there is too little sunshine or too much moisture for cereals. The chief growers are Ireland, Germany, Austria, Hungary, Russia, Poland, the British Isles, and the United States.

Sugar. Sugar is mostly obtained from sugar-cane and sugar-beet. The sugar-cane requires a hot and moist climate and rich soil, and is produced chiefly in India, East and West Indies, China, the Guianas, Brazil, Egypt, Natal, and Queensland. Sugar-beet requires a temperate climate and can grow even in poor soils. It is chiefly grown in Holland, Belgium, Germany, Austria, Russia, Poland, the United States, and Canada.

Spices. Spices are produced mainly in hot lands, as southern India, Indo-China, Ceylon, East and West Indies, East and West Africa, the Seychelles, Madagascar.

and Mauritius. The most important spices are pepper, chillies, cinnamon, nutmeg, cloves, cardamom and ginger.

Tea. Tea consists of the leaves of a plant which requires a warm, moist, sub-tropical climate. The soil should be rich in organic matter, phosphoric acid, and potash. To bring forth new leaves rainfall should be frequent and evenly distributed throughout the year. Hillsides that were once covered with monsoon forests are very good sites for tea plantations, because the soil contains decayed organic matter, and water does not settle there to injure the roots of the plants. Tea is chiefly grown in India, Ceylon, China, Japan, Java, Natal, and Fiji. In India tea is largely produced in Assam, Darjeeling. Kangra, Travancore, and the Nilgiris.

Coffee. Coffee is the fruit of a tree that is grown at lower levels than tea. It requires a warm climate and shelter from violent winds, which would scatter the fruit berries. The shelter is provided in western tropical America by banana and rubber trees, in Brazil by a tall plant of the pea family, and in Mocha (Arabia) by the heavy mist which rises from the waters washing the Yemen coast. Coffee is chiefly grown in Brazil, Bolivia, Mocha, Jamaica, Mexico, Java, India, East Indies, Malaya, Venezuela, and Columbia.

Cocoa. Cocoa is the bean of the cacao tree, which must not be confused with the coco-palm: from this bean cocoa and chocolate are made. As nourishing drinks these surpass coffee and tea. The cacao tree, which is a native of America, requires a hot moist climate, and a deep volcanic soil. It is grown in Ecuador, Peru, Bolivia, Venezuela, the Gold Coast Colony, Brazil, and Nigeria.

Tobacco. Tobacco requires a warm climate and a light alluvial soil, rich in lime and potash. It is of many varieties, which differ with different climates and soils. Heavy soils produce strong tobacco, and light soils produce a mild variety. The chief countries of production are the United States, Mexico, Central America, the north of South America, the West Indies, the East Indies, the Philippines, south-eastern Europe, Egypt, India, and South Africa.

Cinchona. Cinchona is a tropical tree from the bark of which quinine is prepared. It requires a mild and equable climate. It is chiefly grown in Columbia, Jamaica, the Western Ghats, Southern India, Ceylon, Java, and Burma.

Cotton. Cotton is a fibre plant which requires a warm, moist, even climate, and a light soil containing salt and lime. The black-soil, which is retentive of moisture, suits it best. There are two chief varieties, long-stapled and short-stapled. The chief sources of supply are the United States, India, Egypt, China, Japan, Peru, Brazil, Mexico, Persia, West Africa, the West Indies, and Uganda.

Flax. This plant has a wide range of climate. If grown in a warm climate, it yields a good seed, from which linseed oil is extracted; and if grown in a colder climate, it gives a good fibre, from which linen is manufactured. Whether grown for seed or fibre, this plant thrives best in a stiff moist soil, rich in phosphates and decayed vegetable matter. Russia, Holland, Belgium, Ireland, and Northern Italy, are important producers of fibre; while India, Argentina, and the United States produce good seed.

Jute. Jute is a tropical plant from the fibre of which cordage, gunny bags, and sacks are made. It requires great heat, heavy rainfall, and rich alluvial soil. The chief areas of production are Bengal, Ceylon, Formosa, Malaya, and China.

Rubber. This is the solidified juice of several kinds of tropical trees and plants requiring great heat and moisture. Until recently rubber was obtained from wild trees of the equatorial regions of America, Africa, and Asia, but now the rubber trees are cultivated in Brazil, Peru, Central America, the valleys of the Niger and the Congo, Assam, Ceylon, Malay, Sumatra, and Java. The demand for rubber has greatly increased on account of the electrical and motor industries of the United States, the British Isles, Germany, and France.

Fruits. Fruits may be classified as follows:—

(*a*) Those requiring a hot and moist climate. The banana is the typical example. The chief sources of supply are the West Indies, the Canary Islands, tropical Africa, Columbia, Central America, North Australia, and Florida.

(*b*) Those requiring a Mediterranean climate. The most important are oranges, lemons, grapes, currants, figs, almonds, walnuts, mulberries, and pomegranates. The chief regions of production are the countries of southern Europe, northern Africa, California, Cape Province, and Palestine.

(*c*) Those requiring a temperate and sub-tropical climate. The most important are apples, pears, plums, apricots, and peaches. They are grown chiefly in Central and Northern Europe, Southern Australia, New Zealand, Tasmania, and California.

(*d*) Those requiring a hot and dry climate. The most important fruit belonging to this class is the date. The hot desert and semi-desert regions of Persia, Mesopotamia, Arabia, Egypt, and north Africa are the chief homes of the date-palm.

Exercises.

1. Show how the type of vegetation is affected by the amount of heat and moisture.

2. Give the important vegetation zones of the world, naming the characteristic plants of each zone.

3. Give a short description of the vegetation of a mountain.

4. Indicate to what type of vegetation each of the following belongs and name the places where each is found:—

   Ebony, eucalyptus, teak, date-palm, lichen, gum-acacia, pine, chestnut, and spruce.

5. Write notes on:—

   Selvas, pampas, llanos, prairies, steppes, oases, pusztas, campos, and savannahs.

6. What is the characteristic vegetation of deserts?

7. In what countries are the following produced and why?—

   Wheat, rye, rice, tea, coffee, cotton, flax, jute, and rubber.

8. Which parts of Asia belong to the tundras, the forest belt, the steppes, and the monsoon region?

9. Name the chief sugar-yielding plants and state where they are grown.

10. Name the sources of supply of the principal fruits, mentioning the climate required by each.

CHAPTER XII.

ANIMALS AND MINERALS.

Effect of Physical Conditions on Animal Life. Physical conditions have a great effect on animal life. In the cold polar regions many animals are fur-bearing, while in the hot tropics many are almost bare-skinned. Again, the colour of their covering is generally very similar to that of their natural surroundings, a fact that makes them inconspicuous. This inconspicuousness affords them protection from their enemies and helps beasts of prey to procure their food.

The polar bear and other animals of the arctic regions have white coats which match the colour of the snow. Desert animals, such as the camel and the lion, are tawny and are therefore almost indistinguishable from the sand and rocks. Many animals of the grasslands, such as the tiger and the zebra, are striped, and thereby escape notice easily in the lights and shadows of the tall grasses of the wet season and the bare rocks and scanty vegetation of the dry season. Many animals of the forest, like the leopard, have colourings which make them undiscoverable amidst the patches of light and shade caused by the rays of the sun piercing through the leaves and branches of trees. Many forest birds and insects are green like the foliage among which they live.

Distribution of Animal Life. As all animals get their food either directly or indirectly from plants, the distribution of animal life on the earth is closely related to that of plant life. Where the vegetation is luxuriant animals are many; and where the vegetation is scanty, animals are few. The chief divisions are the following:—

(*a*) *Animals of the Equatorial Forests.* In the equatorial forests, as the vegetation is luxuriant, animal life is abundant. On the trees live numbers of monkeys and birds, while lower down are found countless reptiles and insects. The thick undergrowth checks the movements of the larger ground animals, except in the case of the lordly elephant.

(*b*) *Animals of the Tropical Grasslands.* In the savannahs or tropical grasslands such animals are found as live upon grass. The most important are the antelope, the zebra, the giraffe, and various kinds of deer. These grazing animals are in turn preyed upon by lions, leopards, panthers, hyenas, and jackals. In rivers and marshy places the crocodile, the hippopotamus, and the rhinoceros are common.

(*c*) *Animals of the Hot Deserts.* In the hot deserts, as the vegetation is scanty, animals are few. The most important is the camel, which has been called the ship of the desert. Its adaptation to a desert life is seen in its broad-soled feet, the long sheltering eyelashes, the water-pouches of its stomach, and the reserve of fat in the humps. Such birds as cannot fly, but run swiftly, like the ostrich and the emu, are also found in desert tracts.

(*d*) *Animals of the Temperate Lands.* In the temperate lands three kinds of animals are found, *viz.*, the hoofed, the gnawers, and the flesh-eaters. Among hoofed animals are cattle, sheep, pigs, and deer. Among gnawers are squirrels and rabbits. Among the flesh-eaters are bears, wolves, and foxes.

(*e*) *Animals of the Tundras.* As in the hot deserts,

Laplanders with Reindeer.

the vegetation in the tundras or cold deserts is scanty and consequently the number of animals is very limited. The chief vegetation is the moss and lichens which form the food of the reindeer, which may be called the camel of the Arctic desert. Other animals are fur-bearing, such as the polar bear and the fox. In the polar seas are found seals and walruses.

(*f*) *Animals of the Mountains.* In mountains such animals are found as are active and well protected against cold and dryness. The llama and the alpaca in the Andes in South America, the yak in Tibet, and sheep and goats almost everywhere, are the most noteworthy.

(*g*) *Domestic Animals.* Of the foregoing classes of animals some have been domesticated by man. The most important are cattle, sheep, goats, camels, horses, elephants, and reindeer. In addition to meat, cattle supply man chiefly with milk and other dairy produce, while sheep and goats give him wool for clothing. Oxen draw carts and are used for ploughing. Horses are used for riding and driving, and mules and asses are beasts of burden. The camel carries heavy loads across the desert wastes. The elephant is very useful in timber yards. The reindeer supplies the people of the tundras with milk and meat for food, and skin for shelter. It is also used for drawing sledges.

(*h*) *Water Animals.* Of all water animals fish are the most important. They are of various kinds. as the cod, the salmon, and the herring. Fish life depends on abundance of food in the water and on its depth, warmth, and saltness. The cool shallow seas where fish food is plentiful are great fishing-grounds Fish are largely caught near the coasts of western Europe, Newfoundland, Alaska, western Canada, eastern Japan and China. The whale and the seal, which are mammals, not fishes, yield useful products, such as whalebone, sealskin, oil, etc.

Animal Products. The chief commercial products obtained from animals are the following:—

Wool. This is one of the most important of animal products. It is chiefly obtained from sheep and goats, which thrive in dry and temperate climates. In hot countries the wool of sheep and goats usually becomes coarse and hair-like. Wool varies greatly in different countries according to the breed of sheep and the climatic influences. The wool produced by the Angora, Kashmir, and Tibetan goats is very fine, silky and valuable. The chief wool-producing regions are Australia, New Zealand, South Africa, Argentina, India, Germany, England, Russia, and Turkey. The wool of the United States is mostly of inferior quality. Besides sheep and goats the alpaca and the camel also yield wool and hair. From the wool of the alpaca cloth is made, while camel-hair is used in the manufacture of rough shawls and carpets.

Silk. Silk is obtained from the bodies of silkworms. They live upon the leaves of mulberry trees, which prefer a warm and moist climate. The chief silk-producing countries are the monsoon regions of China, Japan, Indo-China and India, and the Mediterranean regions of Italy, Turkey, France and Persia.

Nowadays the manufacture of artificial silk from a chemical preparation of wood-pulp or cotton is a growing industry in the United States, Italy, Great Britain, Germany, and France.

Hides and Skins. The hides of cattle and horses and the skins of sheep and goats are mainly used for making leather.

The chief regions that produce and export hides and skins are the United States, Australia, South Africa, India, South America, Russia, Italy, and Canada.

Feathers. Feathers are largely used for stuffing beds and quilts. They chiefly come from Greenland, Iceland, Norway, France, China, the United States, and Canada. Certain feathers, as those of the ostrich, are used for ornamental purposes, and the merchants of England, Holland, and France import them mainly from South Africa and the East Indies.

Poultry, Eggs, and Meats. Poultry and eggs come from grain-producing countries, while meats are mostly supplied by sheep-rearing countries. Though perishable and difficult to export, they are now sent in great quantities to industrial countries by the help of cold-storage. "Chilled" meat is carried in cold-storage chambers, kept at a temperature of 30° F.; "frozen" meat is actually frozen hard at temperatures between 10° and 15° F.

Distribution of Minerals. Minerals and other treasures of the earth are very unequally distributed. Few countries are so richly blessed as are the United States of America, China, or Russia, where all the important metals and both coal and petroleum are found in ample quantities. Minerals, unlike agricultural products, are liable to become exhausted more or less rapidly. For instance, tin mines have been worked for hundreds of years, but oil wells are often exhausted in a few years. The most important minerals are the following:—

Iron. Of all mineral substances iron is the most important, and with coal is the basis of almost all manufactures. Most modern machinery is made from iron. Machines for developing power, such as steam engines; for transmitting power, as the wires and poles used in conveying electrical energy; and for applying power, such as looms, printing presses and mills, all depend upon iron. Iron seldom occurs in a free or metallic state. Generally it is found combined with other minerals, forming an ore from which it is smelted. It is found chiefly in the United States, Great Britain, Germany, France, Spain, Sweden, Russia, Canada, China, Japan, and India.

Coal is the chief source of power, and with iron it is the foundation of nearly all modern industry and transport. The chief coal-producing countries are the United States, Great Britain, Germany, France, Belgium, South Africa, India, and Canada. China has vast resources of coal, but works it very little.

Petroleum. This is a mineral oil used as a fuel, a lubricant, or an illuminant. The chief products from it are petrol, kerosene, paraffin wax, and natural gas. As paraffin wax is used in candle-making, this industry is carried on where petroleum is found. Natural gas is the first product when borings are made for oil, and is used as fuel, as in Pittsburg in the United States of America. The chief sources of petroleum are the United States, Mexico, Poland, Transcaucasia (Baku), Poland (Galicia), Java, Sumatra, Burma, India, Japan, Persia, Mesopotamia, Canada, Peru, and Columbia.

Gold. Gold is a precious metal which does not tarnish on exposure to air. It is therefore used in the making of jewellery and in coinage. It usually exists in the native state and is found chiefly in South Africa (the Transvaal), the United States, Australia, Canada, India, Mysore, the Gold Coast in West Africa, British Guiana, Russia and Mexico.

Silver. Silver is found both in the native state and in many ores, as those of lead, copper, gold, etc. Besides being used for jewellery and coinage, it is employed in plating base metals and in scientific apparatus. It is found chiefly in the United States, Mexico, Australia (Broken Hill), Canada, Bolivia, and Germany.

Platinum. Platinum is a more precious metal than gold. On account of its resistance to heat and acids, it is highly useful in scientific work; it is also used for jewellery. It is found chiefly in the Ural Mountains, Columbia, and California.

Copper. Next to iron, copper is the most widely used metal. As it is a good conductor it is much used in electrical industries. It is also used for numerous other purposes, either pure or mixed with other metals. If it is mixed with zinc, it makes brass; with tin it produces bronze; and with nickel German-silver is the result. It is found both in the pure state and in the form of ores. The chief sources of supply are the United States, Spain, South Africa, Australia, Japan, Chile, Peru, Germany, and Belgian Congo.

Lead. Lead is used in the making of glass, painters' colours, glaze for pottery, gas and water pipes, and fittings for chemical works. It is largely mined in the United States, Spain, Germany, Australia (Broken Hill), and Mexico.

Zinc. To prevent rust zinc is used for coating wires and sheets of iron; it is also used in the manufacture of rubber. It is found in the United States, Germany, Poland, Australia, Canada, and Western Europe.

Tin. Tin is mostly used as an alloy, that is, mixed with other metals. The chief sources of its supply are the Malay Peninsula, the Dutch East Indies (the islands of Banka and Billiton), Bolivia, Australia, England (Cornwall), China and Nigeria.

Mercury. Mercury or quicksilver is used in its pure state in the making of scientific instruments, such as thermometers and barometers. It combines easily with other metals, and is therefore much employed in gold and silver mining. It comes chiefly from Spain, California, Russia, Mexico, Bolivia, China, and Japan.

Sulphur. Sulphur is usually plentiful in volcanic regions. It is largely used in the preparation of sulphuric acid and the manufacture of gunpowder and matches. It is mined chiefly in the United States, Sicily, Japan, Iceland, Spain, Portugal, France, Norway, New Zealand, and Italy.

Diamonds. The diamond is a very precious stone and is obtained at Kimberley in South Africa Brazil, India, and New South Wales in Australia.

Rock-Salt. Rock-salt is found both in deep beds and in accumulations at the surface. The beds in the Salt Range (Punjab) form the largest known deposits in the world. Rock-salt is widely distributed throughout the Old and New Worlds; it is abundant in the United States. India, Persia, England, Spain, Russia, and Poland.

Exercises.

1. Give a short description to show that animal life is affected by physical conditions and natural surroundings.
2. Describe briefly the distribution of animal life on the surface of the earth.
3. What are the characteristics of the animals of the tropical grasslands? Name some of these animals.
4. Where are the following chiefly found and why:—

   The reindeer, the camel, the polar bear, the fox, the alpaca, the yak, and the elephant.
5. What are the most important animal products? Name the countries where each is found.
6. Name the chief sources of supply of the following, and state for what purpose each is used:—

Petroleum, platinum, copper, lead, zinc, mercury, sulphur, coal, and iron.

7. Enumerate the chief countries from which gold, silver, diamond, tin, and rock-salt are obtained.

8. Locate the great world sources of supply of the following products:—

Silk, hides and skins, feathers, ivory, eggs, meat, and wool.

CHAPTER XIII.

OCCUPATIONS AND INDUSTRIES.

(*a*) *Hunting.* In the history of economic progress hunting represents the lowest scale of civilization. In the beginning it formed the chief means of man's livelihood and was therefore his principal occupation. His needs were few and simple. He lived in caves and huts, and clothed himself in the skins of animals. As game was liable to be exhausted, existence was precarious and life unsettled. One tribe came into collision with another and fights resulted. Men were consequently hardy and strong. At the present day, however, hunting is usually a form of recreation or a means of profit. In the forests of Russia and Canada fur-pearing animals, such as the marten, the fox, the ermine and the sable, are hunted for the sake of their fur. London, Leipzig, Nijni-Novgorod, Yakutsk (Siberia), and New York are some of the great fur-markets of the world. Similarly lions, leopards, and tigers are hunted in the tropical regions of Asia and Africa for their skins, which are used as rugs, and the elephant is hunted for its ivory tusks.

(*b*) *Fishing.* Fishing is a specialized form of hunting, and is now carried on by both the civilized and the uncivilized races of the world. Among the civilized races of the West fishing is an organized industry. The fish are caught on a large scale and are scientifically preserved by salting, freezing, and canning, and exported to other parts of the world. The cold and temperate shallow seas, which abound in the minute vegetable and animal organisms on which fish feed, are very rich in fish. The chief fishing-grounds are the North Sea (Dogger Bank), the Lofoden Islands near Norway, the Iceland banks, the Baltic Sea, the Newfound'and banks, the coasts of Western Canada and Alaska, and the Japan and China seas. The principal countries engaged in this industry are Great Britain, Norway, Russia, the United States, Canada, Newfoundland, Alaska, and Japan. The industry also includes the hunting of whales and seals, which are valued for their fat and the oil extracted from them; the sea' also supplies a beautiful fur.

(*c*) *Pasturing.* When man progressed from mere hunting and fishing to the rearing of herds of cattle and flocks of sheep, he made a great advance. He was now interested in the preservation of life, and not merely in its destruction. Though he was still nomadic, his life was more settled and less precarious. His standard of living also rose. He now used milk for his food, and wool and leather for clothing and shelter. As he had to guard his pastures and protect his cattle, there arose a sort of military organization among the members of a tribe. The nomads of Central Asia, the Hottentots of Africa, and the Todas of India are remnants of primitive pastoral peoples. At the present day pasturing has given place to stock-raising, which is closely connected with agriculture. In various parts of the world animals are now reared scientifically for meat, dairy products, wool, and skins.

(*d*) *Agriculture.* As lands for pasture became scarce and could not support the increasing population, people took to agriculture. The nomadic tribes became attached to the soil, made permanent homes, and practised various arts and industries. Thus we see that early civilization is closely connected with agriculture. It took its rise where soil was fertile and water was available. In the fertile valleys of the Ganges, the Nile, the Tigris and the Euphrates, the Hwangho and the Yangtse-Kiang, India, Egypt, Babylonia, and China developed their memorable civilizations. In India, China, and other Eastern countries agriculture is still practised in the old simple fashion, but in the progressive and civilized countries of the West agriculture with the help of machinery is scientifically carried on. Soils are made to produce more and better products by such means as rotation of crops, chemical manures, dry farming, and artificial irrigation.

We have already seen what agricultural products are grown throughout the world.

(*e*) *Lumbering.* Lumbering is the felling of trees and bringing the timber from the forests. This industry is chiefly carried on in the temperate forests of Scandinavia, Russia, Canada, the United States, and the interior forests of Central Europe. In summer, on account of rainfall and the melting of the snow, streams of water down which heavy logs of timber are floated provide easy and cheap transport. The hard timber of the forests is used for building purposes, and the soft timber for paper-making. In the tropical forests transport is often difficult and hence lumbering cannot be followed on a large scale.

(*f*) *Mining.* Although mining has been practised from remote antiquity, it is only in modern times that it has become a great and highly organised industry. It now requires much capital and the application of science to its development. Yet in spite of difficulties of transport deeper, longer lines of underground railway are laid, and more expensive machinery is employed. To make the mining industry successful, facilities for making use of the minerals in the immediate neighbourhood, or for transporting it to other parts, should exist. Where capital is lacking, transport facilities are often poor and skilled labour is scarce. In such countries as China, Spain, and the Balkans, the mining industry needs more capital for its development. But under difficult transport and unfavourable climatic conditions gold mining is profitably carried on in Alaska and in Western Australia (Coolgardie and Kalgurli). We have already indicated the principal mineral products of the world.

(*g*) *Manufacturing.* The conversion of raw materials into finished products, whether by hand or by machinery, is called manufacturing. This process was at first confined to handicrafts; but nowadays manufactures are mostly carried on by mechanical power in factories. The chief factors which determine the manufactures of a locality are cheap power, nearness of raw material, and means of easy transport. Thus manufacturing on a vast scale is best carried on where coal is available. If iron is also available near the coal it is an additional advantage, for coal is needed for fuel and iron for machinery. But nowadays electricity generated by water-power is also used, as in Switzerland, Norway, Italy, and Japan. Sometimes special factors also play a great part in localizing a manufacturing industry. Thus the moist air of Bombay and Lancashire is very suitable for the cotton manufacture, for where the air is too dry the cotton threads become brittle. Similarly the water of the Rhone at Lyons is well adapted for silk dyeing at that French city.

The chief manufactures and manufacturing regions of to-day are the following:—

(*1*) *Cotton Manufacture.* This requires a damp climate, and a cheap supply of coal to drive machinery.

Hence it is carried on on the moist western slopes of the Pennines in England, especially in Lancashire, where the industry is concentrated to a remarkable degree, the chief cotton towns being Blackburn, Bolton, Oldham and Manchester. Paisley, in the west of Scotland, has a gigantic industry in the making of cotton-thread. In the United States the industry is widely scattered. Bombay and Ahmedabad in India, and Osaka in Japan are busy centres in the East.

(*ii*) *Woollen Manufacture.* The British woollen industry is localized in Yorkshire on the eastern side of the Pennines, which is dry and has pastures for sheep. As the local wool-crop is insufficient, most of the supply comes from other parts of the world, especially Australia, New Zealand, South Africa, and South America. The chief manufacuring towns are Leeds, Huddersfield, Bradford, Leicester, and Paisley in Great Britain; Sedan in France: and Philadelphia in the United States. Kashmir is famous for the manufacture of woollen shawls.

(*iii*) *Silk Manufacture.* Silk manufacture is carried on where raw silk is produced or is really obtainable. Raw silk is produced by silk-worms which feed on the leaves of the mulberry tree. The chief centres are Yokohama in Japan; Canton and Hankow in China; Venetia in Italy; Lyons in France; and Berlin in Germany, The rapid growth of the manufacture of artificial silk has already been referred to in chapter XII.

(*iv*) *Linen Manufacture.* Linen industry grew up in districts where the flax plant flourished and produced a good fibre; but cultivation is declining, owing to the competition of jute and cotton. The industry is still carried on at Belfast and Londonderry in Ireland, and at several towns in the east of Scotland, but much of the fibre is imported. Gorlitz in Germany, Lille in France, and Ghent in Belgium, all have linen factories. Bengal produces jute, which is manufactured at Calcutta. Other tropical vegetable fibres are Manila hemp, which is made into ropes, and ramie or China grass, woven into various fabrics.

(*v*) *Iron Manufacture.* This industry depends not only on the quality and abundance of the iron-ore, but also on the application of science and capital. In the course of manufacture it takes various forms, *e.g.,* pig-iron, cast-iron, wrought-iron, and steel of different qualities. As iron is very heavy, goods are usually manufactured from it in places where it is found near coal and limestone. Limestone is necessary for smelting purposes. This industry is chiefly carried on at Pittsburg, Cleveland, Chicago, Philadelphia and St. Louis, in the United States; Birmingham, Newcastle, Sheffield, the Black Country, Middlesborough, South Wales, and Darlington, in England; Dusseldorf, Essen, Solingen, Bremen, and Chemitz, in Germany; St. Etienne, Lyons, and Le Creusot, in France; Mons, Namur, and Liege, in Belgium.

(*vi*) *Chemical Manufactures.* Chemical manufactures require, besides coal and iron, abundant supply of chemicals and technical skill. They include the making of acids, alkalies, fertilizers, dyes, drugs, paper, glass, soap, leather, etc. In the manufacture of acids, alkalies, and dye-stuffs Germany takes the first position; thousands of dye-stuffs are produced from coal-tar. Next come the United States, Great Britain, France, Poland, Czecho-Slovakia, and Belgium. Electro-chemical goods are manufactured in Germany, Scandinavia, Switzerland, and Italy.

Paper is manufactured from wood-pulp, certain grasses, such as esparto (or alfa), cotton, linen rags, and waste paper. The chief countries of production are Germany, the United States, Scandinavia, Great Britain, Canada, and Japan.

The raw materials for glass are flint, sand and lime. The principal countries manufacturing glass are Germany, Czecho-Slovakia, Austria, Italy, the United States, the British Isles, France, and Japan. Soap is manufactured from soda, potash, animal fats, and vegetable oils. The chief sources of supply are the United States, Great Britain, Germany, and France.

Leather is made from hides and skins acted upon by certain vegetable and mineral substances. Leather goods are manufactured in the United States, Germany, France, and Great Britain.

(*h*) *Trading and Transporting.* This will be dealt with in the next chapter.

Exercises.

1. What are the chief occupations of mankind? Give a short description of each.

2. What is the difference between the hunting of to-day and that of early times?

3. Name some of the animals that are hunted now-a-days. In what parts of the world and for what purpose are they hunted?

4. What are the chief fishing-grounds of the world? Name the countries engaged in this industry.

5. Describe shortly the life of man when pasturing was his chief occupation. What form does pasturing now take among the civilized peoples?

6. "Early civilization followed agriculture." Explain this remark and give illustrations.

7. What is lumbering? In what parts of the world is it carried on?

8. What are the characteristics of mining as a modern industry?

9. What do you understand by manufacturing? Give the chief factors that determine the manufactures.

10. Where are the following manufactures carried on, and why?—

Cotton, woollen, silk, paper, iron, glass, leather, soap, acids, alkalies, and electro-chemical goods.

CHAPTER XIV.

COMMERCE AND COMMUNICATIONS.

Commerce. Trade or commerce is the exchange of commodities of one place with those of another place. Formerly, when journeys were long and expensive, trade was in goods of great value in proportion to their bulk, such as gold, precious stones, ivory, etc. With the opening of railways and the improvement of roads, the development of shipping and the art of navigation, trade has now increased in bulk and deals mainly with the necessaries and comforts of daily life. Each country specializes in those commodities which it can produce at a lower cost than others on account of the favourable circumstances in which it is placed.

Factors of Commerce. The chief factors which determine the commerce of a place are the following:—

1. *Natural Wealth.* This may consist of—

(*a*) *Fertile soil* Wherever soil is fertile vegetable products are in abundance. If they exceed the requirements of the population some of the produce is sent to other parts.

(*b*) *Sufficient rainfall.* No plants can grow without moisture. Wherever the moisture supplied by rains is adequate, good crops are possible. The prosperity of India depends upon the heavy rainfall brought by the monsoons in summer.

When the monsoons fail, not only does the produce decrease, but famine and scarcity are seen everywhere; consequently there can be no trade (*c*) *Rich mineral deposits.* Countries that are rich in minerals, especially coal and iron, are generally manufacturing countries. They import raw materials from other parts of the world, work them into finished products, and send them abroad. Great Britain, France, Germany, the United States and Japan are all manufacturing countries and exchange their manufactured goods for raw materials.

(*d*) *Healthy climate.* A cool temperate climate is healthy and bracing, while a hot damp climate is unhealthy and enervating. This is why the people of Europe are so adventurous and enterprising, and have captured so much of the trade of the world; a vigorous climate makes hardy races.

(*e*) *Favourable winds* also are a natural asset. They may be helpful in various industries, and in level countries, such as Holland, wind-power may be used to drive machinery.

(*f*) *Water-power.* Water-power is a cheap substitute for coal, and thus constitutes an important item of natural wealth; it has been called "white coal." Switzerland and Sweden produce electricity from their waterfalls, and are thereby able to carry on flourishing manufactures, such as the making of watches and matches. Similarly, Italy, which produces no coal, is now making more and more use of her water-power.

2. *Easy means of inland communication.* These consists of—

(*a*) *Navigable rivers.* Rivers that flow through plains are generally slow and navigable, while those in mountainous countries are short and rapid and so unsuitable for navigation. When railways did not exist trade was largely carried by rivers, and the towns situated on their banks were commercial centres. The Ganges is a typical example.

(*b*) *Metalled roads.* Metalled roads also play a great part in the transport of goods from one place to another. Now that motor vehicles are much used for carrying commodities metalled roads have become a necessity.

(*c*) *Railways.* Railways are a cheaper, quicker, and safer means of transport than any other means on land. It is through railways that even perishable commodities can be sold in places thousands of miles away from the source of production. Much of the vast trade of the present day is due to railways.

3. *Relative Position.* The position of a country with respect to other countries is also a great factor in determining its trade. Great Britain is very favourably situated in the middle of the land surface of the earth, so that much of the world's commerce passes through it. Similarly, Japan owes much of her trade to her favourable situation between China and North America, both of which are commercial countries.

4. *Indented Coast-line.* An indented coast-line is a great help to trade, as it provides a number of natural harbours where ships can safely shelter. If the coast line is unbroken, there is a lack of such harbours, as on the west coast of Africa. Great Britain and British Columbia are fortunate in this respect.

Means of Transport. The chief means of transport are the following:—

1. *Human Porters.* They are mostly used in Africa, where animals cannot be used for this purpose owing to the existence of the tse-tse fly, whose bite is fatal. Porters are also used in China, which is mountainous and undeveloped.

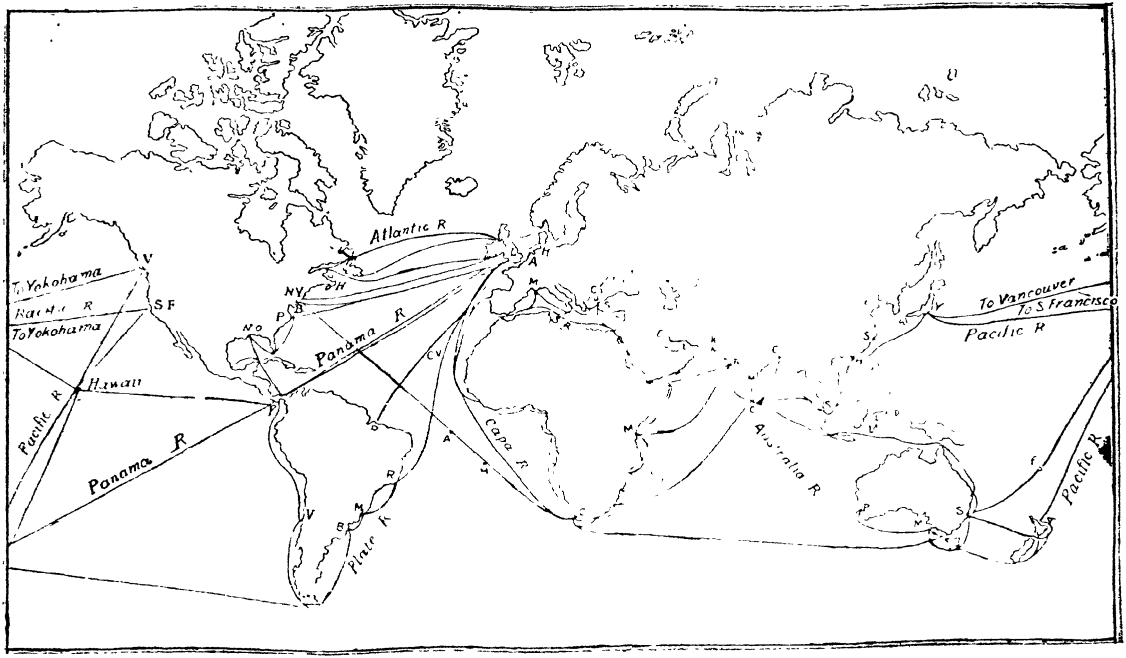
2. *Animals.* Horses, asses, mules, and oxen are

used in temperate and sub-tropical countries. The camel is the chief means of conveyance in regions where food and water are scarce. In the polar regions the reindeer, and in the tropics the elephant, are important means of transport. The yak in Tibet and the llama in Peru and Bolivia are the principal beasts of burden there.

3. *Motor Vehicles.* These require good metalled roads and are being more and more employed for transport; they are now serious competitors with the railways of the western world. During the last two years the total number of motor vehicles imported into India exceeded 40,000.

4. *Railways.* Railways are, as already mentioned, one of the most important means of transport. Their situation is determined by the relief of the country and the productivity of the region. It is difficult and expensive to construct them in mountainous country, while they are easily laid in level country. Even on plains railways follow rivers and valleys, as far as possible, for these afford a natural and cheaper route. Again, railways, if they are to be worked at a profit, must pass through populous and productive areas.

5. *Shipping.* Like railways on the land, ships form the most important means of transport on the water. There are regular routes on the ocean as there are on the land. The sailing routes and the steamship routes are quite distinct. The sailing-ships have to follow a circuitous path in order to take advantage of the winds, currents, and tides; while the steamships follow a direct course in order to save fuel and time. About fifty years ago 90 per cent. of the world's maritime trade was done by sailing vessels, but now about 97 per cent. of this trade is carried on by steamships and motor vessels. Over 30 per cent. of the world's ships now use oil fuel



Map of the World showing Sea Trade Routes.

instead of coal. Ocean steamships are of two classes:—

(*a*) *Liners,* which belong to a special line, run between two fixed termini, and have, like railways, fixed times of arrival and departure.

(*b*) *Tramps,* or freight-vessels, which have no regular routes or fixed timings, but travel from port to port in search of trade. Though much of the world's traffic is carried by the tramps, the liners which carry mails, passengers, and goods are the more important. As the people of western Europe were the pioneers of ocean trade, and as their countries are manufacturing and thickly populated, most of the great ocean routes start from there.

6. *Aerial Transport.* The transport of passengers, mails, and goods by air is becoming more and more important. Some air lines are purely commercial, and some are partly for strategic purposes.

Sea-Trade Routes. The most important sea-trade routes are the following:

1. *The Atlantic Route.* This route lies between western Europe and eastern North America. On account of the great amount of traffic obtained at each of the termini, it is the most important of all the ocean routes. As fuel is abundant on both sides, no mid-Atlantic coaling stations are needed. The chief European termini are Liverpool, Glasgow, London, Southampton, Hamburg, Bremen, Antwerp, Amsterdam, and Havre. The American termini are Montreal, Halifax, New York, Boston, Philadelphia, Baltimore, and New Orleans. The trade on this route consists chiefly in the exchange of the manufactured goods of Europe for the food-stuffs, timber, and raw materials of North America.

2. *The Suez Route.* In volume of traffic this route is reckoned next to the Atlantic route, and is due to the

opening of the Suez Canal in 1869. Starting from London and other termini on both sides of the Atlantic it passes through the Straits of Gibraltar and the Mediterranean Sea, where it is joined by feeders coming from Barcelona, Marseilles, Genoa, Naples, Vienna, Trieste, Algiers, Odessa, and Alexandria. It then goes through the Suez Canal and the Red Sea and reaches Aden. Here it divides into three branches. One branch goes to Karachi and Bombay, another goes to Mombasa, while the third, which is the main branch, goes to Colombo. Here again it branches off in three directions. One branch goes to Madras, Calcutta and Rangoon, another to Australia, while the main line proceeds through the Strait of Malacca to Singapore, Hongkong, Shanghai and Yokohama. The trade of this route consists in an exchange of textiles, hardware, machinery, and other manufactures of the West for the food products (wheat, rice, tea, coffee, spices), and the raw materials (cotton, wool, silk), of the East. As it is a long and important route, it has several coaling and fortified stations. The principal are Gibraltar, Malta, Port Said, Aden, Colombo, Singapore, and Hongkong.

3. *The Cape Route.* This route starts from London and other ports of western Europe, and, calling at Madeira and the Canary Islands, reaches the Cape Verde Islands. Here it is joined by another route coming from the Atlantic ports of the United States. It then proceeds to the islands of Ascension and St. Helena, and reaches Cape Town. Here, while the main line goes direct to Australia, vessels trading with India and the Far East, after calling at the South African ports and at Mauritius, steam north-east to Colombo and join the Suez route. All freight steamers from the United States and Europe use this route to Australia instead of the Suez route. The distance for American vessels is almost the same

as *via* the Suez Canal; and in the case of steamers from European ports, though it is longer by about 1,000 miles, it is cheaper as it escapes the heavy Suez Canal dues. Australasia sends wool, metals (gold, silver, copper, tin), meat, fruits, food-stuffs, timber, and wine, in exchange for European and American textiles, clothing, machinery, and railway plant.

4. *The Plate Route.* This route takes its name from the river Plate or La Plata, the mouth of which lies in this route. Vessels from the European and American ports of the Atlantic meet near Cape St. Roque From that point they call at Rio de Janeiro, Montevideo, and Buenos Ayres, and passing through the Strait of Magellan they go on to the Pacific ports of South and North America. The opening of the Panama Canal has taken away much of the European trade of the Pacific portion of this route. The trade is mainly in manufactured goods of Europe and North America in return for wheat, meat, nitrates, wool, cocoa, coffee, tobacco, rubber, and timber of South America.

5. *The Panama Route.* This route starts from the ports of western Europe and those of the eastern United States. Passing through the Florida Strait and the Windward Passage it connects the ports on the coasts of the Caribbean Sea and the Gulf of Mexico. From thence it passes through the Panama Canal and goes direct to New Zealand. Great Britain and America send manyfactured goods and receive in return sugar, fruits, cocoa, tobacco, and other products of the West Indies, Mexico, Central America, Bolivia, Peru, Chili, and the western United States

6. *The Pacific Routes.* There are two great routes across the Pacific Ocean. One runs direct, as well as through the Hawaiian Islands, from San Francisco,

Vancouver, and Prince Rupert to Yokohama, Shanghai, Hongkong, and Manila; and the other connects the Pacific ports of North America with those of Australia, such as Auckland, Sydney, Melbourne, and the Fiji Islands. The trade consists chiefly in the exchange of the textiles, machinery, metal goods, and railway plant of North America, for the tea, sugar, rice, tobacco, silk, hemp, wheat, and wool of Japan, China, and Australia.

7. *The North Sea and English Channel Routes.* These routes which connect Great Britain with the continental ports are of great commercial importance. The chief ports on the British side are London, Harwich, Grimsby, Hull, and Newcastle; while those on the continent are Dunkirk, Antwerp, Amsterdam, Rotterdam, Bremen, Hamburg, Copenhagen, Stockholm, Leningrad, Riga, Kiel, Calais, and Havre The British ports export coal, cotton and woollen goods, and machinery in return for dairy produce, timber, flax, beet-sugar, wine, glass, dyes, and metals.

Ship-Canals. The great ship-canals of the world are for the most part those that have been constructed through isthmuses to shorten trade routes. The principal are the following :—

1. *The Suez Canal.* This canal connects the Red Sea with the Mediterranean. It was constructed by a French engineer named Ferdinand de Lesseps, and was opened in 1869. Its total length is 101 miles; it is now deep enough to admit vessels drawing 32 feet of water. It is broad enough to allow two vessels to pass each other in almost any part. It is at sea-level throughout; it has no locks like the Panama Canal, and it is open to the vessels of all nations. It has shortened the distance from England to Australia by 1,000 miles, but the taxes charged are so heavy that it is only used by vessels

carrying mails and valuable cargoes requiring rapid passage. About 5,000 ships, mostly British, pass through it yearly.

2. *The Panama Canal.* This canal was opened in 1914. It connects the Caribbean Sea with the Pacific Ocean by cutting through the Isthmus of Panama. The terminus on the Atlantic side is Colon, while that on the Pacific coast is Panama. It is about 50 miles long; its minimum depth is 40 feet; and its width varies from 1,000 to 300 feet. It has a system of locks by which ships are gradually raised to a height of about 80 feet and again lowered to sea-level. It was constructed by the United States originally for naval purposes. It has shortened the Plate route by thousands of miles. It has thus brought the Atlantic ports of North America much nearer to Pacific ports. The distance *via* this canal between New York and San Francisco has been decreased by 9,000 miles, while that between London and San Francisco has been shortened by 6,000 miles. Similarly China, Japan, and Australia have been brought nearer to Europe and eastern North America.

3. *The Kiel Canal.* This canal connects the North Sea with the Baltic Sea and runs across Holland from Kiel on the Baltic to Brunsbuttel at the mouth of the Elbe. It is about 60 miles long, 140 feet wide, and about 40 feet deep, and has locks at each end. It has been of great value to Germany for naval purposes, as well as for commerce. It is open to the vessels of all nations, and has shortened the distance between England and the Baltic by about 240 miles.

4. *The Manchester Ship-Canal.* It runs from Eastham to Manchester, a distance of about 36 miles. It is 28 feet deep and 120 feet wide. It was constructed in 1894 to enable vessels to bring their cargoes of cotton

inland to Manchester, without re-handling them at Liverpool.

The Projected Kra Canal. This is to be cut through the Isthmus of Kra in Lower Burma and will connect the Gulf of Siam with the Indian Ocean. It will shorten the distance between Calcutta and China by about 700 miles and that between Burma and Bangkok by 1,300 miles.

Other ship-canals of some importance are those at Amsterdam (Holland), and Corinth (Greece).

Exercises.

1. What are the chief factors that determine the commerce of a place? Show the effect of each.

2. Explain how fertile soil, healthy climate, favourable winds, and water-power form the natural wealth of a country.

3. What are the chief means of transport now in use? Describe each briefly.

4. Name and describe the most important ocean routes of the world.

5. Name the principal ship-canals of the world, and say in what their value consists.

6. Trace the Suez route and compare it with the Cape route.

7. Describe briefly the Suez and the Panama Canals. In what way has each facilitated trade?

8. Differentiate the following:—

(*a*) Liners and tramps.

(*b*) Steamship routes and sailing routes.

CHAPTER XV.

NATURAL REGIONS OF THE WORLD.

What a Natural Region is. A natural region is a large portion of the earth's surface where the physical conditions, especially relief, rainfall, climate, and vegetation, are almost similar throughout. Thus Europe south of the Alps and Africa north of the Atlas mountains form one region called the Mediterranean region. Here summers are hot and dry, while winters are warm and moist. Rainfall is brought by westerly winds. Vegetation consists mainly of fruits, such as grapes, lemons, oranges. From this we infer that a natural region need not coincide with a political division. A natural region may contain several political divisions, as the Mediterranean region includes Italy, France, Spain, Tunis, and Algeria. On the other hand, one political division may include several natural regions; thus India has three distinct regions, *viz.*, the mountainous region or the Himalayas, the region of low lands or the Indo-Gangetic Plain, and the plateau region or the Deccan. Again, natural regions do not necessarily lie close to one another. Cape Colony and south-east Australia are regions quite similar to the Mediterranean region, though they lie far apart Thus we see that natural regions are very useful in helping us to view the earth as a whole.

Chief Natural Regions. It should be remembered that natural regions are not divided from one another by hard and fast lines, but merge into one another. The principal regions are the following:--

1. *Hot Regions.* These include—

(*a*) *Sahra Type.* The Sahra, Arabia, Syria, Rajputana, the Great Basin (U.S.A.), and the Australian deserts. Here there is no rainfall, because for six months they are in the track of the trade-winds which, coming from land, bring no rain; and for the other six months, these places are in the Calms of Cancer and Capricorn, where the air is always descending and hence no condensation takes place. On account of the lack of rain there is no vegetation except in oases, where date-palms and millets are grown. The people are usually nomadic. The camel is the chief beast of burden. It should be noted that the Nile Valley is really one vast oasis in the great desert stretching from the Sahra to Arabia, but it is irrigated by water brought from the wetter regions of the south.

(*b*) *Monsoon Type.* India (excluding the Punjab), Burma, Siam, Indo-China, Southern China, Central America, the Caribbean seaboard, West Indies, the Brazilian sea-coast, Abyssinia, Madagascar, and north-east Australia. Here the summers are hot and rainy, while the winters are comparatively dry. Agriculture is the predominant occupation of the people. Rice, maize, sugar, tobacco, cotton, coffee, tea, rubber, jute, and oilseeds are the principal crops.

(*c*) *Sudan Type.* The Sudan, the Zambezi valley, the Punjab, the Orinoco basin, and southern Brazil. These lands have heavy rainfall in summer. The range of temperature varies with the elevation. There are only two seasons, the wet and the dry. During the wet season long grasses grow, on which sheep and cattle are reared. Thus the campos and pampas of the Plate basin, the llanos of the Orinoco, and the savannahs of the Sudan.

provide much of the beef and mutton sent to European countries.

(*d*) *Ecuador Type.* Ecuador, the East African plateau, Yemen, the Deccan, Columbia, and Mexico. Though situated near the tropics these plateaus have a low temperature on account of their altitude. Thus Quito, though situated on the equator, enjoys a mild climate throughout the year; the average temperature is only 55 degrees and the annual range is less than one degree. The Ecuador plateau is, therefore, called the "Land of Eternal Spring."

(*e*) *Amazon Type.* The Amazon basin, the Congo basin, the Guinea coast, the Malay Peninsula, and the Malay Archipelago. These lowlands, situated near the equator, are very hot and receive a very heavy rainfall throughout the year. The range of temperature between the hottest and coldest months is less than 5 degrees. Similarly the differences between day and night temperatures are small. Dense forests of mahogany, log-wood, and rubber provide the chief occupation. Owing to difficulties of climate and transport these forests are not economically important. In the clearings sugar, rice, and bananas are cultivated.

2. *Warm Temperate Regions.* These include—

(*a*) *Mediterranean Type.* Mediterranean coast lands (including Spain, Portugal, France, Asia Minor, Algeria, and Tunis), California, central Chile, Cape Colony, southern Australia, and northern New Zealand. These lands are mostly situated on the western side of the great land masses. In winter the "Westerlies" blow from the sea and bring heavy rainfall. In summer they are in the track of the trade-winds which, coming from land, bring no rain. Thus hot dry summers and mild rainy winters are the chief characteristic of these regions. Fruits, such as grapes, lemons, oranges, and apricots, are very widely cultivated.

(*b*) *North China Type.* Northern China, Southern Japan, the Eastern United States, south-eastern Brazil, Uruguay, and the south-eastern coast lands of Australia. These lands are all situated on the eastern side of their continents. They have hot summers and cold winters; the rainfall is in summer. The vegetation is rich on account of the heat and moisture. Agriculture is very widely practised. Japan and the United States have also become great industrial and commercial regions.

(*c*) *Turan Type.* Turan lands near the Caspian Sea, Rumania, Hungary, Manchuria, the west central United States, Northern Argentine, and the interior parts of New South Wales and Victoria. These lowlands, being situated in the interior, have scanty rainfall and extremes of temperature. Grass grows on which cattle, sheep, and goats are reared. Where sufficient water is available, maize, wheat, and barley are cultivated.

(*d*) *Iran Type.* Iran or Persian plateau, the interior of Asia Minor, Afghanistan, Baluchistan, Mongolia, the Colorado plateau, Patagonia, and interior South Africa. These lands are all plateaus. Being situated in the interior and shut in by mountains, moisture-bearing winds do not reach them. Hence rainfall is scanty and the climate is extreme. Even rich grassland is not found. On account of the mountainous nature of these countries, intercourse is difficult, and the people are therefore backward.

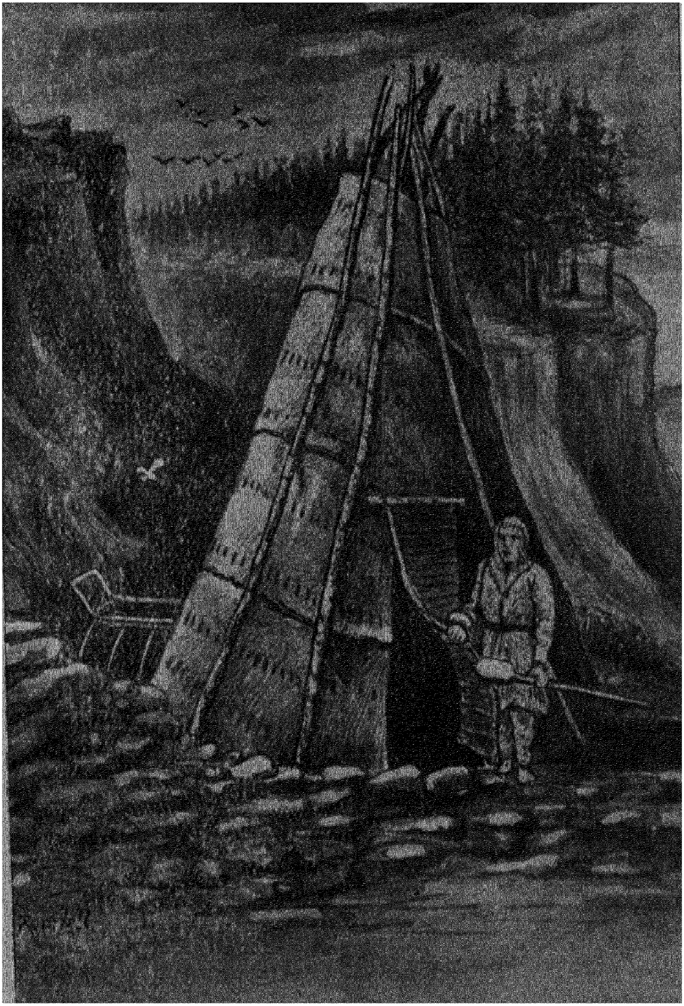
3. *Cool Temperate Regions.* These include—

(*a*) *West European Type.* The British Isles, south-western Scandinavia, Denmark, western Germany, Holland. Belgium, France (excluding south), northern Spain, southern Chile, Tasmania, British Columbia and the north-western United States. These places are all situated on the western margins of land masses and under the influence of westerly winds. These winds bring moisture from the warm Atlantic and Pacific Oceans and give rainfall throughout the year. The climate is therefore equable and temperate; the people are energetic, and can work all the year round. On account of their rich mineral resources and favourable situation for trade and commerce, these countries have become the seats of important manufactures and are very densely populated.

(*b*) *St. Lawrence Type*. Basin of the St. Lawrence (eastern Canada and U.S.A.), Newfoundland, southern Argentina, northern Japan, eastern Korea, and Armenia. These lands are all situated on the eastern margin of the cool temperate regions. The rainfall is chiefly in summer and not so abundant as in the countries lying on the western margin. Winters are therefore much colder and summers slightly warmer.

(*c*) *Siberian Type*. Siberia, the Steppes of Central Asia, Poland, and the northern prairie lands of North America. As they are interior lowlands, rainfall is scanty, and chiefly in summer on account of cyclonic storms rising from the Pacific Ocean. The climate is therefore extreme, that is, the winters are long and severe, while the summers are hot. Towards the north are found coniferous trees, which are followed by deciduous ones in the south. Further south there are grasslands, called prairies in North America and steppes in Asia. Trees are found where moisture is available, that is, in the valleys of rivers and streams. The prairies have now been to a great extent brought under cultivation and produce excellent wheat.

(*d*) *Tibet Type*. Tibet, Peru, Bolivia, and Chile. These are high plateaus with little rainfall. The air is extremely dry, which causes extremes of temperature.



An Eskimo standing before a hut made of the tent-covers provided by reindeer.

The soil is stony and poor. The vegetation consists of patches of grass and low stunted plants, which provide food for llamas, alpacas, and yaks.

4. *Polar Regions.* These include—

(*a*) *Tundras Type.* The tundras or cold deserts are marshy lowlands bordering the Arctic Ocean. The climate is extremely cold, with no rainfall. For nine months these regions lie covered with snow and ice, which melt somewhat in summer. Little grows except mosses and lichens, which form the food of the reindeer. The reindeer is here a very important animal. It supplies the Eskimos with meat and milk for food, as well as skin for clothing and tents, and it draws their sledges. The chief occupations are hunting and fishing.

(*b*) *Norway Type.* Northern Norway, Iceland, Alaska, Kamchatka and Greenland. These are high lands situated in the polar regions and are for the most part sparsely inhabited, as they are snow-bound for the greater part of the year. But in parts of Norway, Iceland, and Labrador there is a settled population trading in salt fish, cod-liver oil, reindeer skin, the fat of the polar bear, and various furs, all products of these regions.

Factors of Economic Development. We see that some countries like Germany and the United States are highly developed, while others, such as India, China, and Egypt, are still backward and undeveloped. The chief causes that contribute to the economic development of a country are:—

1. *Situation.* Some countries are more favourably situated than others. Great Britain has an insular position and thus, though a part of Europe, is yet apart from it. The sea is a natural bulwark of the greatest value, and has helped to give the peace and security essential to the internal development of the country. Moreover,

lying as already stated in the centre of the land hemisphere, it is within easy reach of all the great world's markets. On the other hand, India is part of a vast continent and has ever been subject to foreign invasions.

2. *Sea Coast.* As the sea is a great highway of trade, the possession of a long indented sea-coast is a valuable asset. Great Britain has a highly indented coast-line which provides a number of safe and natural harbours, and leaves no part of the interior very far from the sea and its influences. Thus not only is transport of goods cheap and easy, but the people are naturally a nation of sailors, able and ready for daring voyages and enterprises. Hungary and Poland, though situated in the very midst of civilized Europe, have remained comparatively backward, both economically and politically, on account of their having no adequate outlet to the sea.

3. *Relief.* Mountains are great barriers to communications and advancement; it has been said that seas unite nations, but mountains divide them. A level country affords easy means of communication. The rivers are usually long and navigable, and roads and railways can be easily and cheaply built. Thus Tibet and Afghanistan may be contrasted with India in regard to the development of roads and railways.

4. *Climate.* A climate which is neither very cold nor very hot is healthy and conducive to energy. The people of countries having such a climate can work vigorously throughout the year. But there is no such continuity of work and vigour in countries having a hot and damp climate. Thus the people of Japan, who enjoy a mild and equable climate, are industrious and hardworking, and have made their country one of the foremost powers in the world; while Russia, though much bigger in size, has remained relatively a backward country.

One of the reasons is that it has extremes of climate which do not admit of work all the year round.

5. *Soil.* Soil also plays a great part in retarding or promoting the economic development of a country Where the soil is fertile, the agricultural products can generally satisfy the requirements of the people of the country, and also leave a surplus which can be exported in return for raw materials and manufactured products Thus the United States, where wheat, cotton, and other produce are grown in abundance, is more advanced than Persia and Arabia, where the soil is mostly barren.

6. *Mineral Wealth.* Mineral wealth constitutes, if not the foremost, at least one of the most important, factors of economic development. Iron and coal are the basis of all manufactures, one providing the machinery and the other the fuel.

Finished products, as they are due to skilled labour, fetch a higher price than the raw material. Thus a manufacturing country is necessarily more economically developed than an agricultural one. It can not only manufacture its own raw products, but also those of other countries. The United States, Japan, England, Germany, and Belgium are all rich in mineral products and hence their economic advance.

7. *Character of the People.* While all the rest are passive factors in the economic development of a country, the character of the people is the active cause. A country may be blessed with one or all the factors already named, and yet be backward owing merely to some defect in the character of its people. But we must not treat national character as independent of geographical conditions. Moreover, race, religion, history, and government, are all elements in the formation of character. Few countries are as rich in mineral wealth and fertility of the soil as

China, which has other advantages also, and yet it is still a backward country. Cut off from the rest of the world by high mountains, a vast desert, and a wide ocean, the Chinese made little progress for many centuries. Their suspicion of foreigners, their want of enterprise, their superstitions, and other characteristics, have hitherto prevented them from utilizing and developing the rich resources of their country. On the other hand, the people of Germany, which possesses other advantages only in a moderate degree, have made their country a great power, highly developed socially and economically, by their ability, intelligence, and scientific knowledge.

Exercises.

1. What is a natural region? Explain, and give examples.
2. " A natural region need not coincide with a political division." Account for this statement and illustrate it fully.
3. Name the chief natural regions of the world and give a short description of each.
4. What countries are included in the Mediterranean, the monsoon, and the Iran types of regions. Give the characteristic climate, vegetation, and other features of each.
5. What geographical conditions determine the economic development of a country?
6. Illustrate the fact that the character of the people is the active cause of the economic development of a country.
7. Give instances to show how the geographical position of a country helps or hinders its internal development.

8. Why are England, Germany, and the United States highly developed; while India, China, and Egypt are still backward?

PART III—GENERAL GEOGRAPHY OF ASIA.

CHAPTER XVI.

PHYSICAL FEATURES, ETC.

Position and Size. If we look at the map of Asia, we see that the whole of the mainland lies north of the Equator. Its most northerly point, Cape Chelyuskin, is within 13 degrees of the North Pole, and its most southerly point, Cape Romania, is only one degree north of the Equator. Thus it stretches through 76 degrees of latitude. Again, its extreme western point, Cape Baba Burun, is 27° E., and its extreme eastern point, East Cape, is 170° W. It thus includes 163 degrees of longitude. Its total length is 5,350 miles from north to south and 5,990 miles from east to west. It comprises with its islands an area of 17,600,000 square miles, which is about one-third of the land-surface of the globe. Thus it is the largest of all the continents, being half as large again as Africa, more than four times the size of Europe, and six times as large as Australia.

Coast-line. The coast of Asia is not so much indented as that of Europe or North America. In proportion to its size the length of its coast is very short, being about 5,000 miles only. It has only one mile of coast to 500 square miles of surface, while Europe has a mile of coast to every 200 square miles of surface.

North Coast. The north coast is well indented, but as it is washed by the Arctic Ocean, which remains frozen for most part of the year, it has no commercial importance. This coast is the edge of the frozen tundras where neither animal nor vegetable life can flourish.

East Coast. The eastern side of Asia has a double coast-line owing to the chain of islands running parallel to it. The most important of these islands are the Aleutians, the Kuriles, Sakhalin, Japan, Formosa, the Philippines, Borneo, and the Malay Archipelago. At one time these islands formed a part of the mainland from which they became separated by the upheaval of the earth. Between these islands and the mainland there is a series of inland seas which, being joined to each other, form one long inland sea. This coast is high and well-indented, and therefore has been commercially important from very early times except at the cold northern end. The southern portion has several important harbours. *Port Arthur,* to the south of Manchuria, lies at the head of the Gulf of Pecheli and is a very important naval station and railway terminus belonging to Japan. *Shanghai* stands near the mouth of the Yangtse-kiang and is the natural outlet of the fertile valley behind. It is the collecting and distributing centre for central and northern China. It exports silk, cotton, and tea. *Canton,* on a distributory of the Si-kiang, owes its importance as a commercial centre to its position. It is connected by waterways and railways with almost every part of the fertile and well-populated region around it, and is accessible by even large ocean-going steamers. It manufactures cotton and silk goods and porcelain. Opposite Canton stands *Hong-Kong,* which belongs to Great Britain. It has an excellent harbour. It is a naval and military station, and guards the British trade route in the Far East. Besides, it is an important centre of trade and carries on sugar-refining and other industries; more than a quarter of the whole foreign trade of China passes through it.

South Coast. This coast is washed by the Indian Ocean, and has the three large peninsulas of Indo-China, India, and Arabia, projecting southwards. The coast of Indo-China is well indented and has several good harbours.

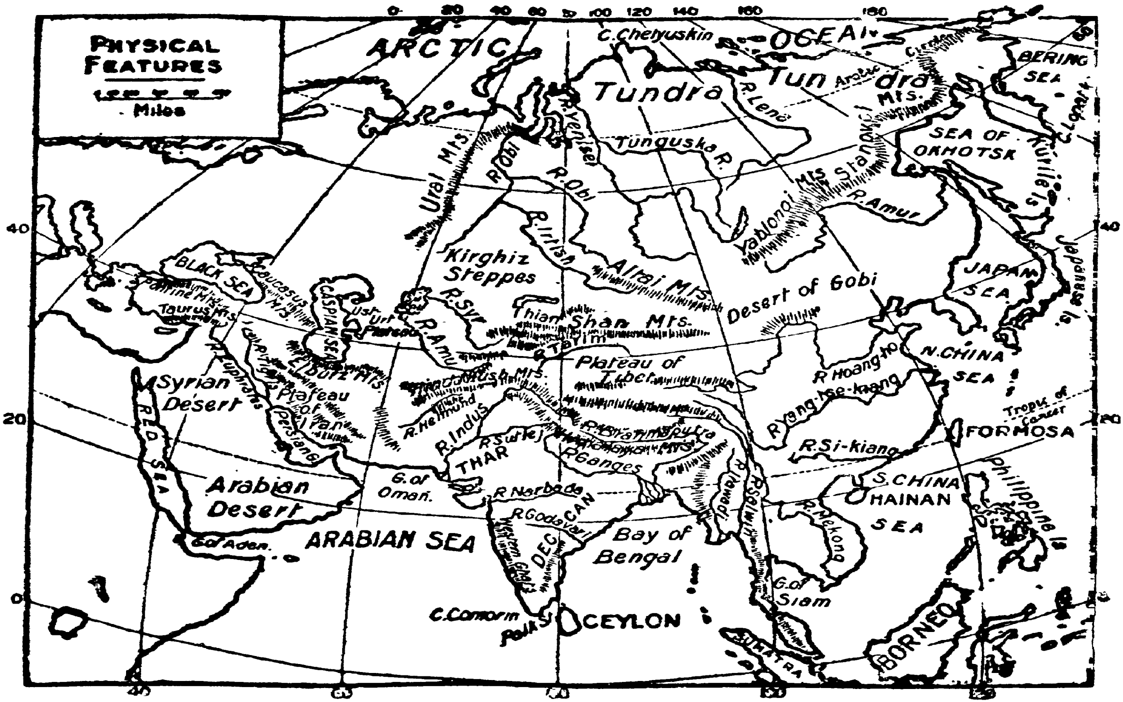
Singapore, belonging to the British, is situated at the south end of the Malay Peninsula and at the head of the Malacca Strait. As it commands the entrance to the Far East, it is a very important naval, military, and wireless station, and a centre of trade. It collects tin, rubber and spices for export, and imports rice, cotton goods, and machinery for distribution.

Rangoon is the capital and chief seaport of Burma. It is situated at the junction of three rivers about 21 miles from the sea, and carries on an extensive trade by rail and river with the interior. It exports rice, timber, ivory, mineral oil, and precious stones.

The Indian coast is not broken and has therefore few harbours of importance in comparison with the size of the country. But measures are now in progress for the development of the harbours of Vizagapatam, Tuticorin, Cochin, and Kathiawar.

Calcutta, the former capital of India, is situated on the left bank of the Hugli, which is navigable up to the city for large vessels. If Howrah and other suburbs be included, it is still the largest city of India. The valleys of the Ganges and the Brahmaputra are very fertile and find in Calcutta a natural outlet for their produce. The chief exports are opium, cotton, rice, jute, gunny bags, tea, indigo, oil-seeds, and raw silk.

Bombay, the great rival of Calcutta, has the finest harbour in India. Looking towards Europe and connected by rail with all parts of the country, it has become one


PHYSICAL FEATURES
Miles
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20
40
60
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100
120
140
160
180
ARCTIC
OCEAN
C. Chelyuskin
Arctic Circle
Tundra
Tundra
R. Lena
Mts.
BERING SEA
C. Lopatka
SEA OF OKHOTSK
Kurile Is.
Stanovoi Mts
Yablonoi Mts
R. Amur
Tunguska R.
R. Yenisei
R. Obi
R. Obi
Ural Mts.
R. Irtish
Altai Mts.
Kirghiz Steppes
R. Syr
Thian Shan Mts.
Desert of Gobi
JAPAN SEA
Japanese Is.
BLACK SEA
Caucasus Mts.
Pontine Mts.
Taurus Mts.
CASPIAN SEA
Ust Urt Plateau
R. Amu
Tarim
Plateau of Tibet
Hindu Kush Mts.
R. Hoang-ho
N. CHINA SEA
R. Yang-tse-kiang
Tropic of Cancer
FORMOSA
R. Tigris
R. Euphrates
Syrian Desert
Elburz Mts.
Plateau of Iran
R. Helmund
R. Indus
Persian G.
R. Sutlej
R. Brahmaputra
Himalaya Mts.
R. Ganges
R. Si-kiang
THAR
RED SEA
Arabian Desert
G. of Oman
R. Narbada
R. Godavari
DECCAN
Western Ghats
R. Irawadi
R. Salwin
S. CHINA SEA
HAINAN
R. Mekong
Philippine Is.
G. of Aden
ARABIAN SEA
Bay of Bengal
G. of Siam
C. Comorin
Palk St.
CEYLON
SUMATRA
BORNEO
40
20
0

of the great cities of the world.

Karachi stands on a low and sandy coast at the northern end of the Indus delta. As it is the nearest Indian port to Europe and is connected by rail with the fertile and well-irrigated plains of the Punjab it has become the chief wheat port of India. It is also the terminus of the air route from Egypt and Iraq.

Aden, the Gibraltar of the Indian Ocean, stands near the head of the southern entrance to the Red Sea. As it guards the British trade route to India and Australia. it has become a great naval and coaling station. Its commercial importance is due to its being a collecting and distributing centre for goods from different parts of Europe, Asia, and the east coast of Africa.

West Coast. This coast is washed by the Red Sea, Mediterranean Sea, Sea of Marmora and the Black Sea. The Red Sea coast is unbroken and *Jedda* is its only port. As Arabia is largely a hot sandy desert, peopled by backward tribes, Jedda cannot develop like Bombay and Calcutta, which have rich and fertile regions behind them. The Levant, or the Mediterranean coast of Syria and Palestine, has *Beirut* as its port; this is connected by railway with Damascus. The coast of Asia Minor is high and is broken by numerous inlets.

Smyrna has a good natural harbour and exports the Mediterranean produce of the country, such as wheat, wool, and fruits.

Physical Features. Asia is divided physically as follows:—

1. *Northern Plain.* This plain stretches from the Ural Mountains and the Caspian Sea in the west to the Behring Strait in the east, and from the central high lands of the continent in the south to the shores of the Arctic Ocean in the north. It is in fact a continuation

of the European plain, for the Ural Mountains which separate the two are not high. Moreover, between the southern end of the Ural Mountains and the northern shores of the Caspian Sea, there is not even a ridge of mountains. For this reason Europe and Asia may be regarded as one great land mass, to which the name *Eurasia* is applied. The vast northern plain is broader and lower in the south-west and gets gradually higher and narrower towards the north-east, with a general slope towards the north. That this plain is lower towards the south west is clear from the presence of a number of lakes: the Caspian Sea, the Sea of Aral, and Lake Balkash. All of these lakes have rivers flowing into them. The Caspian Sea, which is 84 feet below the level of the Black Sea, receives the Volga and the Ural; The Syr Darya or Jaxartes and the Amu Darya or Oxus fall into the Aral Sea; and the Ili flows into the Lake Balkhash. All these lakes are salt. It is believed that at one time they were a part of the ocean, whose waters were driven back by an upheaval of the earth, leaving the depressions in the form of lakes Such an area is called an area of *inland drainage*. The rest of the plain is drained by three rivers, the Obi, the Yenisei, and the Lena, which flow into the Arctic Ocean. They rise in the central highlands and after a short mountainous course flow sluggishly over the plain. As they remain frozen in winter they are of no use for navigation, in spite of their slow current. But they have triburaries running almost east and west, which afford a continuous water supply in summer when the snow melts in their upper courses.

2. *Central Highlands.* The central highlands run across the middle of the continent from Asia Minor in the west to the Behring Strait in the east. They consist

of several plateaus enclosed by high mountain-ranges, all of which seem to start from the Pamir Plateau. This plateau is the highest region in the world and is often called "the roof of the world." The chief mountain chains which start from the Pamir Plateau are:—

(*a*) *The Himalayas.* These consist of several lofty ranges separated by valleys, and shoot out in the south-east direction. They are continued southwards in the Naga and Arakan Yoma hills of Burma, the Andaman and Nicobar Islands, and Sumatra and Java.

(*b*) *The Kuen-lun mountains* take off to the east and at about longitude 100 degrees E. are divided into two branches. One branch runs eastward into China as the *Tsingling* mountains, and the other runs north-east as the *Inshan* and *Khingan* mountains. The Himalayas in the south and the Kuen-lun in the north enclose the plateau of Tibet. The Khinghan mountains form the eastern boundary of the Mongolian plateau.

(*c*) *The Thian-shan mountains* run in the north-east direction and enclose between themselves on the north and the Kuen-lun on the south the inland basin of the Tarim, which flows into the rapidly drying marshes of Lake Lob-Nor. North-east of the Thian-shan run the ancient mountains called the *Altai, Yablonoi,* and *Stanovoi.* These form the northern boundary of the Asiatic mountain system and enclose between the Inshan and Khingan mountains the plateau of Mongolia. The Altai mountains are very rich in gold and are therefore sometimes called "the golden mountains." Between the Altai and the Thian-shan, which differ in structure from each other, lies a gap called the Zungarian pass. This gap allows communication between Siberia and Mongolia.

(*d*) *The Hindu Kush.* Just as the Himalayas, the Kuen-lun and the Thian-shan shoot out from the Pamir

Plateau towards the east, the Hindu Kush mountains break off towards the west. They are continued as the *Elburz, Ararat, Pontus,* and *Caucasus* mountains in the north, and the *Sulaiman, Zagros, Kurdistan,* and *Taurus* mountains in the south. Between the Pontus and the Taurus lies the plateau of Asia Minor, while the Elburz in the north and the Kurdistan and Zagros mountains in the south enclose the plateau of Iran. On the eastern side of this plateau is Lake Hamun, into which flows the inland river *Helmand*. In Syria there is another area of inland drainage, formed by the river Jordan which flows into the Dead Sea, 1,300 feet below sea-level. While there are so many salt-water lakes there are only two fresh-water lakes of note in Asia: *Lake Baikal*, which is drained by the Angora, a tributary of the Lena; and the *Wular Lake* in Kashmir, which is drained by the Jhelum. Remember that lakes which send out rivers are fresh-water lakes, while those which have no outlet are generally salt-water lakes. The case of Lob-Nor is interesting. Its waters are fresh, although no river seems to flow out of it; but in reality its waters flow on till they evaporate and deposit a crust of salt on the ground.

3. *Southern Lowlands.* These include four plains: Mesopotamia, the Indo-Gangetic plain, Indo-China, and China. As all these lowlands have been formed by the silt and mud brought down by the rivers flowing across them, they are very fertile. Mesopotamia is watered by the Tigris and the Euphrates, which flow into the Persian Gulf. The Indo-Gangetic plain is watered by the rivers Indus, Ganges, and the lower course of the Brahmaputra. Indo-China or the plains of Lower Burma, Siam, and Cambodia, is watered by the Irawadi, Salwin, Menam and Mekong. Similarly the plain of China is fed by the Yangtse-kiang, the Hwangho and the Amur. As the

soil of these lowlands was fertile even in ancient times, the prosperous inhabitants had leisure to devote to their own self-improvement. Hence these plains were the seats of early civilization. The remains of ancient Nineveh and Babylon in Mesopotamia and Angkor in Cambodia all speak of former greatness. These plains are still very fertile and therefore very populous.

4. *Southern Tablelands.* These consist of Arabia and the Deccan. These tablelands are very similar in structure to those of Africa and Western Australia, all of which surround the Indian Ocean. It is thought that at one time they formed part of one vast continent, which broke up into its present shape by the subsidence and upheaval of the earth. Arabia, though still separated by a narrow channel, has many of the physical features of Africa; and Ceylon is a detached portion of the Deccan, to which it was formerly joined. Similarly, numerous islands in the Indian Ocean are the peaks of a land which now lies under water. And the Dutch Indies form a kind of bridge to Australia, which many ages ago had a land-connection with Asia.

5. *Eastern Chain of Islands.* These islands are the true limits of Asia, with which they were at one time connected. They begin at the south of the peninsula of Kamchatka and end in Sumatra. These islands are volcanic, and the soil is therefore very fertile. This volcanic belt extends all round the margin of the Pacific Ocean and is sometimes called "The Fiery Ring of the Pacific." Of the volcanoes, *Fuji Yama*, the sacred mountain of Japan, has the most perfect cone, and with the perpetual snow at the top it forms one of the most fascinating sights in the world.

Exercises.

1. What is the size of Asia? Compare it with Europe, and with Australia.

2. Describe the coast of Asia. Why is the north coast of so little value in spite of its many inlets?

3. How is the east coast of Asia affected by the chain of islands lying along it. Why has it been commercially important from ancient times?

4. Describe a coasting voyage from Singapore to Smyrna, mentioning the important ports passed on the way.

5. Into what regions would you divide Asia according to their physical features? Give a short description of each.

6. Give reasons why you would expect many political frontiers to meet in the Pamirs.

7. How would you account for the numerous salt-water lakes of Russian Central Asia? What rivers do they receive? Why is Lake Baikal a fresh-water lake?

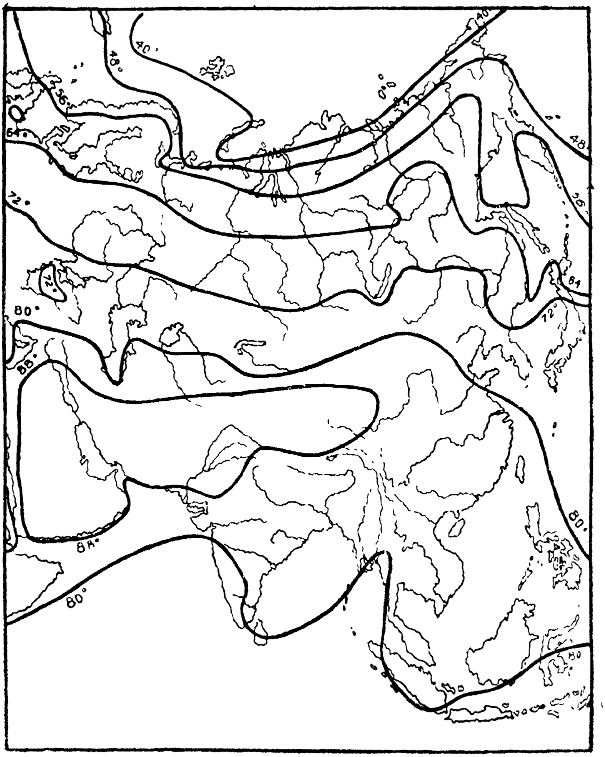
8. Name the ranges that radiate from the Pamir. Why is the latter called "the Roof of the World"?

9. On what grounds may we infer that Africa, Asia, and Australia at one time formed one continent?

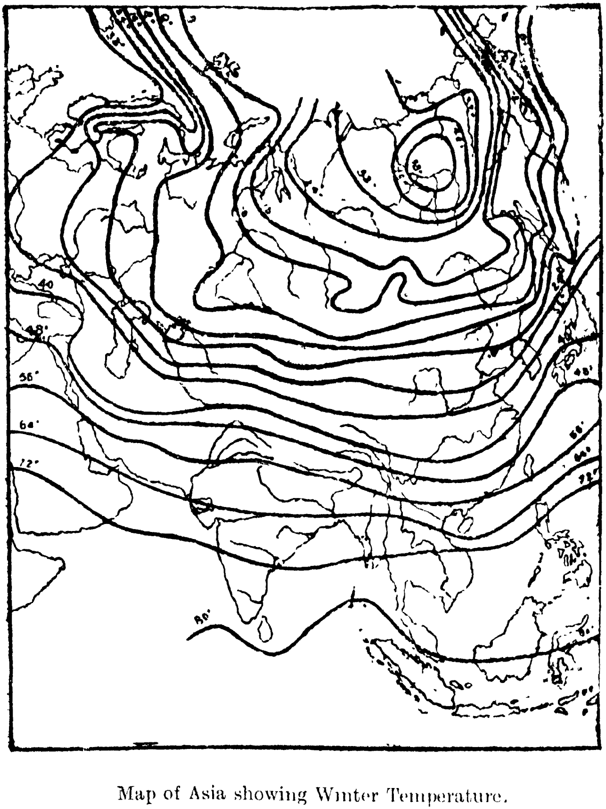
10. On the outline map of Asia mark all the chief rivers and shade the map so as to show the land drained—

(*a*) To the Arctic Ocean, (*b*) to the Pacific Ocean, (*c*) to the Indian Ocean.

11. Asia has vast regions whose waters have no outlet to the ocean. On an outline map mark the areas of inland drainage.



Map of Asia showing Summer Temperature.



Map of Asia showing Winter Temperature.

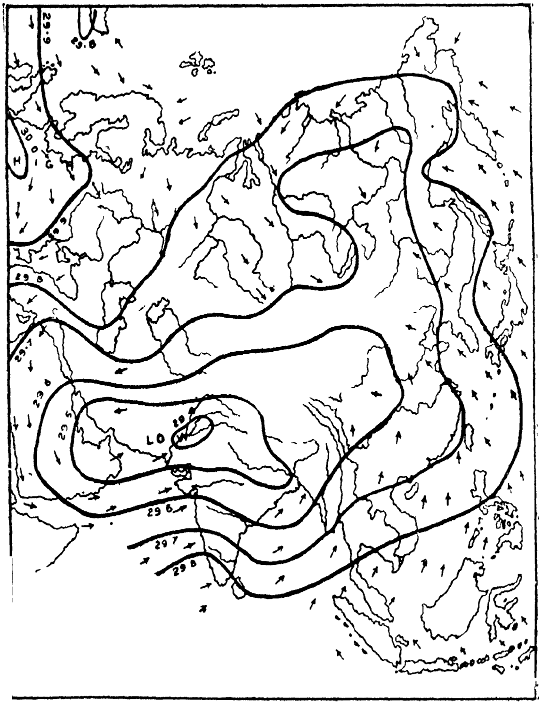
CHAPTER XVII.

CLIMATE AND NATURAL REGIONS OF ASIA.

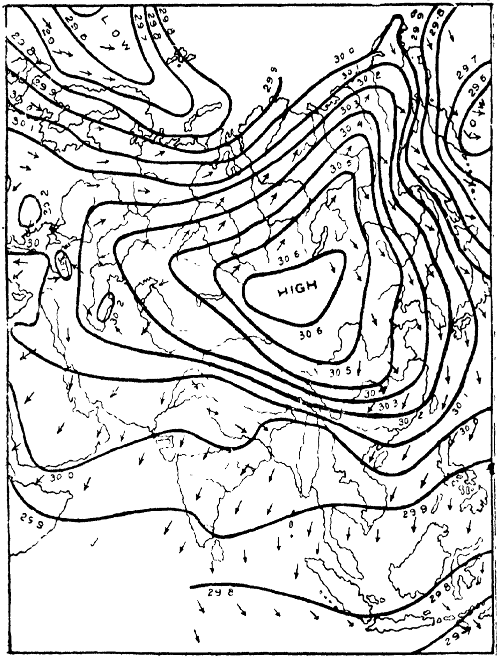
Climate. As Asia is a vast continent, it cannot have one uniform climate. It has in fact a variety of climates, ranging from the hottest to the coldest and from the wettest to the driest.

(*a*) In the extreme north, which is far removed from the equator and very near the polar regions, the climate is extremely cold in winter, very much below the freezing-point. The winters are long and severe, and the summers are short and warm. The western half is warmer than the eastern half, which is exposed to the cold winds coming from the cold Mongolian plateau. Verkhoyansk and Yakutsk, whose winter temperatures are —60° F. and —47° F. and summer temperatures are 60° F. and 66° F., respectively, are typical examples of the eastern half. Tomsk (—3° F. winter temperature, 66° F. summer temperature) and Tobolsk (—2° F. winter temperature, 64° F. summer temperature) are typical instances of the western half. Verkhoyansk has the lowest recorded temperature in the whole world.

(*b*) The south-west part of the northern lowlands, that is, the country near the Caspian and the Aral Seas, has hotter summers and warmer winters than those of the north. Tashkent, with 81° F. as summer temperature and 30° F. as winter temperature, is the typical example. As this region is situated at a very great distance from the ocean and is beyond the reach of the oceanic winds it receives very little rainfall.



Map of Asia showing Summer Pressure.



Map of Asia showing Winter Pressure

(*c*) The Central Plateaus, *i.e.*, the plateaus of Pamir, Tibet and Mongolia, are situated on the leeward side of the highlands of northern India and China. As these highlands block the moisture-bearing winds of the Indian and Pacific Oceans, these plateaus are rainless deserts. Besides, as they are very high, they have very cold winters, and extremely hot summers. The annual range of temperature is the greatest in the world. Such a climate is called a *continental climate.*

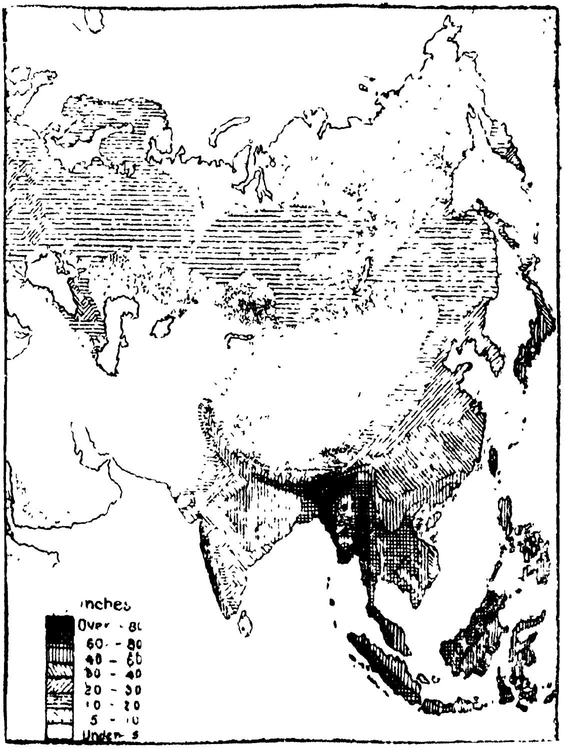
(*d*) The south-west part of Asia, which includes Asia Minor, Syria, Palestine, Armenia and Mesopotamia, has a Mediterranean climate. The summers are hot and dry, and the winters are mild and rainy. The winter rain is due to the ".Westerlies" which blow from the Mediterranean Sea. During summer this region is under the influence of the trade-winds, which, coming from land. bring no rain. Trebizond (41° F. winter temperature and 75° F. summer temperature) and Smyrna (47° F. winter temperature and 80° F. summer temperature) are typical examples.

(*e*) The south-western plateaus, which include Arabia, Persia, Baluchistan, and Rajputana, form a separate climatic region. Their summer temperature is over 90° F. and winter temperature 60° F., with no rainfall. They are rainless for two reasons:

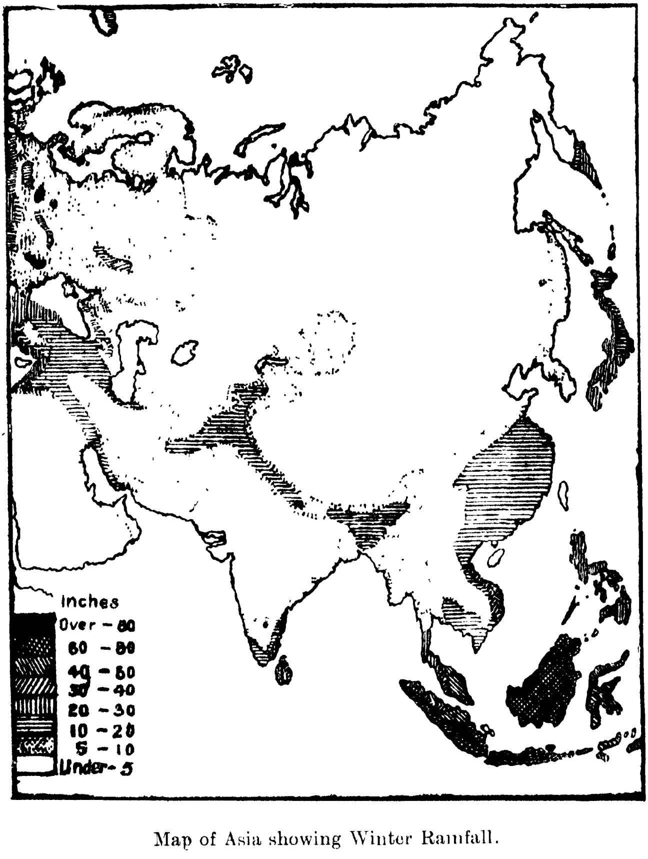
(*i*) For six months they are within the Tropic of Cancer belt of calms, where the air is always descending from cooler to warmer regions. No condensation takes place on account of increase of temperature.

(*ii*) For the other six months they are within the range of trade-winds, which, coming from cold dry areas, bring no rain.

(*f*) The south-eastern part of Asia, which includes India, Indo-China, China, and Japan, has a hot and moist



Map of Asia showing Summer Rainfall.



Map of Asia showing Winter Rainfall.

climate, with rainfall in summer. Such a climate is called a *monsoon climate.* In the southern parts the climate is uniformly hot throughout the year, with a small range of temperature. Bombay (75° F. winter temperature, 85° F. summer temperature) and Rangoon (75° winter temperature, 85° F. summer temperature) are typical examples. The north-eastern parts have hot summers but comparatively cold winters. Hankow (38° F. winter temperature, 83° summer temperature) and Pekin (23° F. winter temperature, 80° F. summer temperature) are typical examples.

(*g*) The Malay Archipelago and the East Indies, being situated in the equatorial regions, have a uniformly hot and moist climate, with abundance of rainfall throughout the year.

Distribution of Rainfall. From the above we can find the general distribution of rainfall in Asia, which is as follows:—

(*a*) *Region of constant rainfall.* The Malay Archipelago.

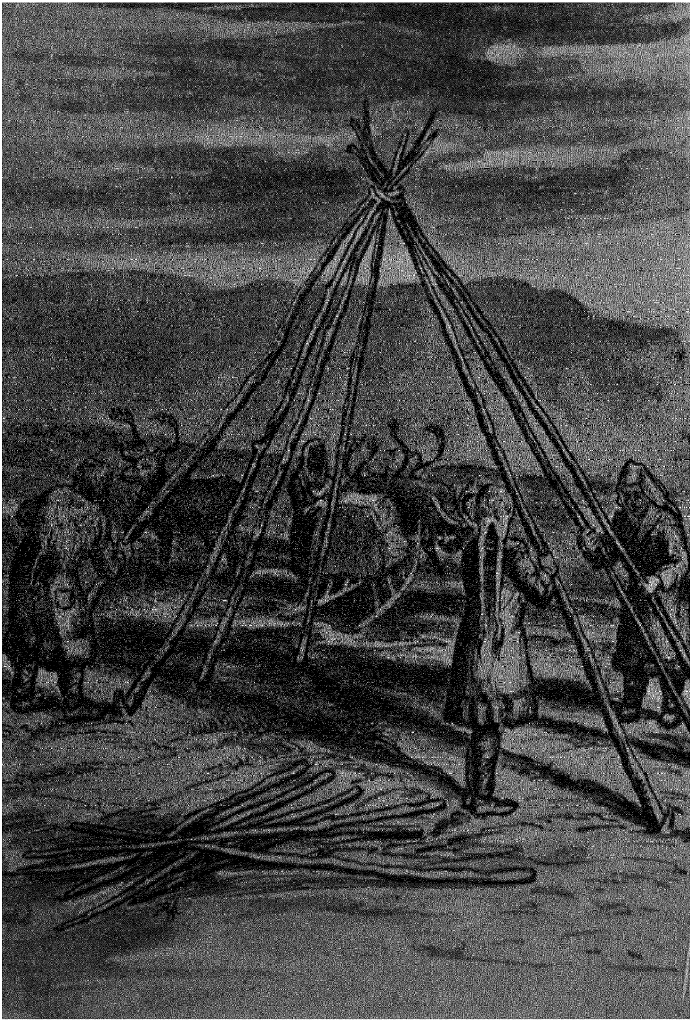
(*b*) *Regions of summer rainfall.* India, Indo-China, China, and Japan.

(*c*) *Regions of winter rainfall.* Asia Minor, Armenia, Syria, and Palestine.

(*d*) *Regions of no rainfall.* Arabia, Persia, Rajputana, Baluchistan, Tibet, Mongolia, and Turan.

Natural Regions of Asia. We can now divide Asia into its main natural regions and thereby study its vegetation, its animals, the occupations of its peoples, and density of its population. The chief natural regions are the following:—

(*a*) *The Tundras.* The Tundras are the ice deserts bordering the Arctic Ocean. As they remain frozen for the greater part of the year, nothing grows



People of the Tundras, with a sledge and reindeer, building huts.

there except ferns, mosses, and lichens in summer when the snow melts. As vegetation is scanty both people and animals are few in number. The inhabitants belong to different races and are known as Eskimos, Ostyaks, Samoyeds, and Yakuts. Their chief occupations are hunting, fishing, and the rearing of reindeer. Reindeer, which feed upon moss and lichen, are indispensable to these people. When alive, the reindeer is used as a beast of burden, draws sledges, and provides milk. When killed, its skin is used for clothing and tent covers, its flesh for food, its horns and bones for tools, and its sinews for thread. Among the animals hunted are the polar bear, seal, and Arctic fox. The people live a nomadic or wandering life.

(*b*) *Siberian Forest Area.* South of the Tundras a great belt of forests stretches across the continent. In its northern portion grow cone-bearing trees, such as pine and fir, while the southern part is covered with deciduous or broad-leaved trees, such as birch and spruce. These forests are not commercially important, as transport is very difficult. The rivers are the only means of transport, and as they remain frozen in winter and flow northwards into the Arctic Ocean they are of little use. But these forests are home of the fox, the marten, the sable, and other animals which are hunted for the sake of their fur. The trapping of these animals is the chief occupation of the scanty population.

(*c*) *Steppes.* Steppes are the grassy lowlands situated to the south-west of Siberia. Owing to the great distance from the sea, the climate is extreme. In summer, when the rain falls and ice and snow melt, these plains become green with grass, which makes excellent pasture for herds of cattle and flocks of sheep. In the river valleys where sufficient water is available, agriculture is carried on. Thus stock-rearing, wheat-growing, and dairy-farming are the chief occupations. As the inhabitants have to wander with their animals in search of pasture they live a nomadic life, carrying all their belongings with them. They therefore live in tents made of skins and felts. Their furniture consists of carpets and rugs made from the wool of sheep and goats, and household utensils which are made of leather or wood so as to be light and not easily broken. Milk and flesh form the most important articles of food. The horse is the most important beast of burden, and the people are very fine horsemen and sturdy fighters.

(*d*) *Turan.* This lowland region lies immediately below the steppes between the Central Highlands in the east and the Caspian Sea on the west and stretches southwards to the Iran plateau. Except in the north it is shut in by high mountains which cut it off from the rain-bearing winds of the Pacific and the Indian Oceans. But as the mountains get rain they become covered with snow, which melts and gives rise to the Syr-Darya and the Amu-Darya. Except in the river valleys, where wheat, maize, cotton, and mulberry are grown, the land is a semi-desert with meagre pasture. The chief occupation on the poor pastures is the rearing of sheep and cattle. The nomadic shepherds very often make raids on the settled inhabitants of the river valleys. The population is therefore sparse, and the towns are few and situated in the fertile river valleys.

(*e*) *Central Plateaus.* The central plateaus or the elevated deserts of the interior consist chiefly of Tibet, the Tarim basin, and Mongolia. As they are shut off from the rain-bearing winds of the Pacific and the Indian Oceans, they are rainless. The winters are very cold, and therefore these lands are covered with snow in that season. Both population and vegetation are sparse. The dromedary or two-humped camel in Mongolia and the yak in Tibet are the chief beasts of burden. Here and there are scrublands and poor pastures, which feed sheep, cattle, and horses. The people are rude and nomadic. Settled life is possible only where water is available throughout the year.

(*f*) *Tropical Deserts.* These include the deserts of Arabia, Iran, Baluchistan, and Rajputana. As they are off the track of the summer monsoons, and within the Tropic of Cancer belt of calms for six months, they are quite rainless. They are not so cold in winter as the cold deserts of the interior. These dry lands absorb heat during the daytime as rapidly as they give it out during the night. Thus there is constant expansion and contraction of the rocks, which crumble ultimately into sand. Nothing grows on these sandy wastes except such plants as have long roots to draw water from great depths and thick branches with prickly leaves to resist evaporation. The people and the towns are naturally few. The camel, the ship of the desert, is the chief beast of burden. The people are nomads and used to fighting. They rear fine horses, those of Arabia being famous.

(*g*) *Mediterranean Region.* The Asiatic countries included in this region are Asia Minor, Syria, coastal Palestine, Armenia, Transcaucasia, west Persia, and Mesopotamia. Thus this region stretches from the Mediterranean Sea on the west to the plateau of Iran on the east, and from Transcaucasia on the north to the outskirts of Arabia on the south. The rainfall is in winter and is brought by the "Westerlies" which blow from the Mediterranean Sea. The summers are hot and dry. As we go away from the coast into the interior the rainfall diminishes and the heat increases until the Mediterranean climate merges into the desert extremes. Hence the products are to some extent of a semi-desert nature. The plants have thick leaves or long roots, such as oranges, figs, lemons, the vine, apricots, and pomegrânates. The chief crops are wheat, barley, cotton, and tobacco. Mulberry trees are extensively grown for the rearing of silk-worms. The drier plateau of the interior is covered with grass which supports sheep and goats. " The Three W's., " *viz.*, wheat, wool, and wine, are the outstanding typical products of a Mediterranean region.

(*h*) *Monsoon Lands.* In contrast to the Mediterranean region, these lands have hot wet summers and dry winters. Owing to elevation, distance from the sea, and distance from the equator, there is a great difference between the temperatures of the northern and the southern parts of the region. This region is consequently divided into two parts, a temperate region and a tropical region

The temperate region includes Korea, Manchuria, northern China, and Japan. The tropical region consists of India, Indo-China and southern China. The chief products are such as require great heat and moisture at the same time. Rice, sugar-cane, cotton, tobacco, opium, tea, and coffee are the principal examples. In the drier parts wheat is grown. The mountains are covered with dense forests of teak and other timber. In China and Japan the mulberry is very widely cultivated in order to feed silk-worms. The animal life is as varied as the vegetation. Such wild animals as the elephant, the tiger, the jackal, the leopard, and the monkey are commonly found in the jungles. The elephant is used as a beast of burden in Burma and Siam. The ox and the buffalo are everywhere used both as beasts of burden and for ploughing the fields. As vegetation is very luxuriant this region is very densely populated, and there are consequently many important cities and towns. The chief occupations of the people are agriculture and manufacturing.

(*i*) *South Eastern Archipelago.* This region comprises the East Indies and the Philippines. As they lie on or near the equator, their chief characteristics are great heat and heavy rainfall throughout the year. The vegetation is therefore very luxuriant and exceedingly rich. Everywhere, especially on the lowlands, the land is covered with dense forests. In the clearings the sago-palm, coconuts, bananas, rubber, spices, sugar, and tobacco are cultivated. As man can satisfy his needs here without much exertion on his part, there has been little incentive to industry and progress. Consequently this region is still the seat of an inferior civilization.

Exercises.

1. Into what climatic regions would you divide Asia? Give the characteristic climate of each.

2. Why is it that (*a*) Asia Minor and Syria have rain chiefly in winter, (*b*) India, China, and Indo-China have it in summer, and (*d*) Tibet and Mongolia never have it?

3. Divide Asia into its main natural regions, giving the characteristic vegetation and animals of each.

4. What zones of vegetation would you pass through on a journey from the Mediterranean to the Arctic coast of Asia? Account for the changes you notice.

5. Describe the life of the people living in the Tundras and compare it with that of the people living in the Steppes.

6. Compare and contrast the Monsoon and the Mediterranean regions of Asia with respect to rainfall, climate, natural vegetation, and density of population.

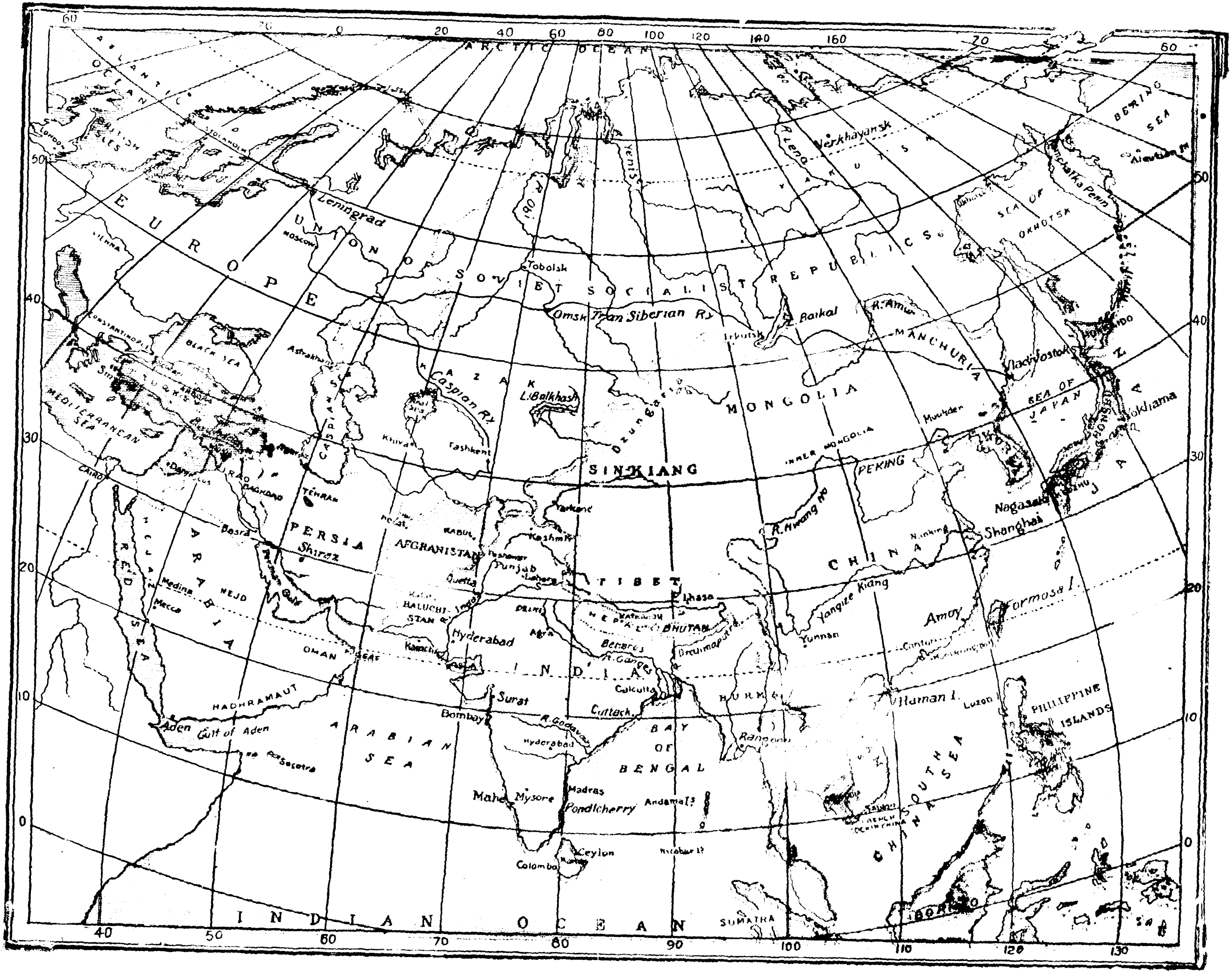
7. Describe as vividly as you can the differences as regards natural vegetation and human occupation between the cold and the hot deserts of Asia.

8. What causes south-eastern Asia and the East Indies to be so productive? Give some of the chief products.

9. Name the chief parts in which each of the following is a very important product:—rice, wheat, tea, spices, coconuts, rubber, and fruits (such as grapes and lemons). Give reasons for your answer.

10. A, B, C, and D, are four towns in Asia. From the climatic figures given below state the natural region in which each is situated, and give its probable vegetation :—

Place.	Jany Temperature.	July Temperature.	Mean Annual rainfall in inches.
A	77°F.	80°F.	105 (mainly in summer.)
B	80°F.	82°F.	95 (at all seasons)
C	45°F.	75°F.	35 (mainly in winter.)
D	—2°F.	88°F.	


ARCTIC OCEAN
ATLANTIC OCEAN
BRITISH ISLES
LONDON
STOCKHOLM
E U R O P E
VIENNA
Leningrad
MOSCOW
UNION OF SOVIET SOCIALIST REPUBLICS
R. Ob
Yenisei
R. Lena
Verkhayansk
Y A K U T S K
Tobolsk
Omsk
Tran Siberian Ry
Irkutsk
Baikal
R. Amur
MANCHURIA
SEA OF OKHOTSK
Kamchatka Penin
BERING SEA
Aleutian Is
Kurile Is
HOKKAIDO
Vladivostok
SEA OF JAPAN
Mukden
KOREA
J A P A N
Yokohama
Nagasaki
KYUSHU
CONSTANTINOPLE
BLACK SEA
Astrakhan
CASPIAN SEA
K A Z A K
Caspian Ry
L. Balkhash
ARAL SEA
MONGOLIA
INNER MONGOLIA
PEKING
Khiva
Tashkent
SINKIANG
MEDITERRANEAN SEA
Smyrna
TURKEY
Damascus
CAIRO
IRAQ
BAGHDAD
TEHRAN
PERSIA
Shiraz
Basra
Herat
KABUL
AFGHANISTAN
Peshawar
Yarkand
Kashmir
Punjab
Lahore
Quetta
BALUCHISTAN
Indus
DELHI
Agra
T I B E T
Lhasa
NEPAL
KATMANDU
BHUTAN
Brahmaputra
R. Hwang Ho
C H I N A
Nanking
Shanghai
Yangtze Kiang
Yunnan
Amoy
Canton
Formosa I.
RED SEA
HEJAZ
A R A B I A
NEJD
Medina
Mecca
Persian Gulf
OMAN
Karachi
Hyderabad
Benares
R. Ganges
I N D I A
Calcutta
BURMA
Hainan I.
Luzon
PHILIPPINE ISLANDS
HADHRAMAUT
Aden
Gulf of Aden
Socotra
ARABIAN SEA
Surat
Bombay
R. Godavari
Hyderabad
Cuttack
BAY OF BENGAL
Rangoon
Mahe
Mysore
Madras
Pondicherry
Andaman Is
FRENCH INDO CHINA
Saigon
SOUTH CHINA SEA
Ceylon
Colombo
Nicobar Is
SUMATRA
BORNEO
I N D I A N   O C E A N
60
70
0
20
40
60
80
100
120
140
160
20
60
50
40
30
20
10
0
40
50
60
70
80
90
100
110
120
130

CHAPTER XVIII.

RUSSIA IN ASIA.

Recent Political Changes. On March 12, 1917, a revolution broke out in Russia, as a result of which the Emperor Nicholas II abdicated. After a few provisional governments, the old Russian Empire finally broke up into four principal republics which entered on December 30, 1922, into a treaty of union, called the Union of Socialist Soviet Republics. The Union then comprised (1) The Russian Socialist Federal Soviet Republic (R.S.F.S.R.), or briefly Russia proper; (2) The Ukrainian Socialist Soviet Republic (U.S.S.R.), or briefly Ukraine; (3) The White Russian Socialist Soviet Republic (W.R.S.S.R.), or briefly White Russia; (4) The Transcaucasian Socialist Federal Soviet Republic (T.S.F.S.R.), or briefly the Transcaucasian Federation. The Transcaucasian Federation consists of three republics, (*i*) Armenia (Socialist Soviet Republic of Armenia) (*ii*) Azerbaijan (Azerbaijan Socialist Soviet Republic), and (*iii*) Georgia (Georgian Socialist Soviet Republic)—all situated on this side of the Caucasus mountains. In September 1924 the Uzbek S.S.R. and Turkoman S.S.R. were formed and joined the Union. Thus the greater part of the former Russian Empire is under the rule of the Soviet Government, which now controls over eight million square miles of territory in Europe and Asia. It may be explained that Soviets are Councils of workers of all kinds, who send their representatives to the Union Congress of Soviets meeting in Moscow.

But a number of states, *viz.*, Finland. Poland, Estonia, Latvia and Lithuania which formerly belonged to the Russian Empire, have been recognised as independent.

Of the Soviet republics, the following fall in the continent of Asia: a large portion of the R.S.F.S.R. lying on the Siberian side of the Ural mountains, Uzbek S.S.R., Turkoman S.S.R., and the Republics of Armenia, Azerbaijan and Georgia. Geographically we may divide Asiatic Russia into (*i*) Siberia, (*ii*) Russian Central Asia, and (*iii*) Transcaucasia.

1.—SIBERIA.

Extent and Physical Features. Siberia is that part of Asiatic Russia which drains to the Arctic and Pacific Oceans. It has an area of over 5 millions square miles, and consists of a vast low-lying plain rising gradually from the Arctic Ocean southwards. Towards the south-east the land is mountainous. The chief mountains are the Altai, the Stanovoi, and the Yablonoi, which form its southern boundary. The Ural mountains are its western boundary. Siberia is drained to the Arctic Ocean by the Obi, Yenisei and Lena and to the Pacific by the Amur. The Obi, Yenisei and Lena are amongst the longest and slowest rivers in the world, but, as they remain frozen in winter and flow into the Arctic Ocean, they are not commercially important. The chief tributary of the Obi is the Irtish, and that of the Yenisei is the Angora which rises from Lake Baikal. This is the largest fresh-water lake in Asia, and has been formed in a rift-valley by the subsidence of the earth's crust. Another remarkable feature is that seals, which are ocean animals, are found in this lake. This shows that at one time the lake was connected with the Arctic Ocean. The Obi and Yenisei are connected by a canal. The Lena, unlike the other Siberian rivers, forms a large delta at its mouth. The Amur, which makes part of the boundary between Siberia and Manchuria, flows through a fertile region and falls into the Sea of Okhotsk.

Climate and Products. The climate of Siberia is very cold and dry, with a great range of temperature. The winters are long and severe, especially in the north-east. Yakutsk has —47° F. as its mean January temperature and Verkhoyansk —60° F. (or 92° F. below freezing point). This excessive cold is due to three causes:—

(*i*) Siberia is exposed to the cold blasts of the Arctic north; (*ii*) it is shut off from the warm winds of the south by mountains; and (*iii*) it slopes towards the north, that is, away from the sun. The excessive cold prevents much evaporation and therefore the rainfall is scanty. The ground is covered with snow for several months in the year. The south-eastern part, which is mountainous and near the Pacific Ocean, has a moderate rainfall.

Siberia is made up of three distinct natural regions: (*i*) The Tundras, which are merely frozen deserts. Here nothing grows except moss, lichen, and stunted shrubs upon which the reindeer feed. The chief occupations of the people are hunting and fishing. (*ii*) South of the Tundras lies the forest, which consists of cone-bearing trees in the north and deciduous trees in the south; it is the largest tree-covered area in the world. On account of the difficulty of transport this forest cannot be of much commercial value except as the home of valuable fur-bearing animals. Yet where clearings have been made towns have grown up, the trees supplying material for house-building, road-making, furniture, and fuel. (*iii*) In the south west lies a broad stretch of the steppes or grassy plains where cattle are reared in large numbers. As the soil is fertile, enormous crops of wheat, oats, and rye are raised. The making of butter is one of the chief industries. This region is at the present time the scene of the greatest economic activity in Siberia. It is the most densely populated region in Siberia and contains over two-thirds of the total population of the country. Siberia is rich in minerals, especially gold, silver, platinum, copper, iron, and coal, but they are little worked.

Important Towns. On account of the severity of the climate Siberia is thinly populated. Most of the towns are situated in the fertile steppes, and are connected by the *Trans-Siberian Railway*. As it gives Europe rapid and direct access to China, Japan, and the East this railway is one of the most important in the world. Starting from Leningrad, formerly Petrograd, it passes through Moscow, and Samara on the Volga. From there it runs to Omsk on the Irtish. *Omsk*, the capital of the Steppe, is the centre of a rich, black-earth region in which wheat-growing, dairy-farming and stock-rearing are important industries. It is the most important town in the agricultural area of Siberia. From Omsk the railway continues eastward, sending a branch line to *Tomsk*, which stands on the Tom, a tributary of the Obi. It is a mining centre and the capital of western Siberia. The line then reaches *Irkutsk*, the capital of eastern Siberia. Thence it runs along the southern shores of Lake Baikal and divides near *Chita* into two branches. One branch runs along the River Amur, crosses it at *Khabarovsk*, and terminates at *Vladivostock*, the Russian naval station on the Pacific; while the other branch runs across Manchuria to *Harbin*, where it again branches. One branch goes south *via* Mukden to *Port Arthur*, which the Russians lost in the war with Japan in 1905.

The other branch continues to Vladivostock. Other towns are *Kiakhta* and *Tobolsk.* Kiakhta lies on the Mongolian frontier, and is the chief centre of trade with China. Tobolsk is situated north-west of Omsk at the confluence of the Irtish and the Tobol. Although it is not a railway station, it commands important trade routes and has a university.

2.—RUSSIAN CENTRAL ASIA.

Physical Features. Russian Central Asia is that part of Asia which is bordered by Siberia, Chinese Turkistan, the Pamirs, Afghanistan, Persia, and the Caspian Sea. It consists of a mountainous region in the south-east and the dry plain of Turan in the west It is an area of inland drainage and has three salt-water lakes, the Caspian Sea, the Sea of Aral, and Lake Balkhash. This region was once the bed of an ocean which was connected with the Black Sea and the Arctic Ocean. The Sea of Aral receives the Syr-Darya and the Amu-Darya, while the Ili falls into Lake Balkhash. The Zarafshan, on which stands Samarkand and Bokhara, and the Murghab, on which Merv stands, both lose themselves in the sands of the desert.

Climate and Products. Except in the north this region is cut off by high mountains from rain-bearing winds. Rainfall is therefore scanty, and the climate one of extremes. The summers are very hot and the winters are very cold. Hence much of the land is desert or semi-desert, whose poor pastures support a scanty population of nomadic herdsmen. In the valleys of the rivers, which are fed by the melting of the snow on the southern mountains, water is available for irrigation and agriculture is carried on. Here wheat, maize, wine, cotton, and tobacco are cultivated. The Ferghana valley in the south-east is the most fertile part.

Chief Towns. The chief towns are situated in places where settled life based on irrigation and cultivation is possible. *Tashkent*, the political and commercial centre of Turan, is situated in the best part of the Syr valley. It is the principal town in Central Asia and has flourishing leather and silk industries. *Kokand* is also irrigated by the waters of the Syr and is an important trading centre. *Samarkand* and *Bokhara* are ancient cities in the valley of the Zarafshan, which loses itself in the sand. As Bokhara is at the end of the river, it does not get sufficient water, and is therefore declining. Samarkand, on the other hand, is higher up the river, and is of increasing importance. Samarkand was once the capital of the vast empire of Tamerlane and is now the capital of the new republic of Uzbekistan. Bokhara was once a famous centre of literature and science. Being the meeting-place of caravan routes from Russia, Persia, India and China, it is an important centre of trade, but most of the trade with European Russia is now effected by the Trans-Caspian Railway.

Merv, on the Murghab, is a very old trading centre, and was formerly a slave-market. *Khiva*, south of the sea of Aral, once had a large slave-market, but is now a small town. All these towns are connected by the *Trans-Caspian Railway*, which is the chief highway of commerce. Starting from *Krasnovodsk* on the Caspian Sea it goes to *Merv*, whence a branch line runs southwards to Kushk near Herat on the Afghanistan frontier. From Merv the main line passes through Bokhara and Samarkand and reaches Tashkent, whence a branch line runs to Kokand. From Tashkent the railway follows the Steppe region to *Orenburg*, and joins the Trans-

Siberian railway at Samara. This railway was made partly to open up the region to European trade and partly to further the extension of the Russian Empire in the direction of Persia, Afghanistan, and India.

Politically Russian Central Asia comprises the republics of Uzbek (Uzbekistan), Turkmenistan, and Kirghiz, with a protectorate over Mongolia since 1924. Bokhara and eastern Khiva, which before the Revolution formed part of the Russian Empire, were joined in September 1924 to form the republic of Uzbek, to which a further part of Khiva was added in 1925. The rest of Khiva now forms part of the Turkoman republic (Turkmenistan).

Transcaucasia. Transcaucasia forms geographically part of the Mediterranean region. It will therefore be treated under that region.

Exercises.

1. What is the form of Government in Russia? Describe shortly the recent political changes in that country.

2. Describe the climatic changes and the types of vegetation that you would encounter in a journey from the mouth of the Yenisei to the Sea of Aral.

3. In what ways does climate affect the lives of the dwellers on the tundras and the steppes?

4. Estimate the value of the Siberian forests and waterways.

5. An express train takes 10 days to run from Moscow to Vladivostok. Calculate the average speed.

(Suggestion—Find the distance between Moscow and Vladivostok with the help of the map-scale given in your Atlas.)

6. What factors have led to the growth and im-

portance of Omsk, Vladivostok, Tomsk, Irkutsk, Kiakhta, Tashkent, Samarkand? Locate them on the map.

7. "The Russian lands occupy about one-third of Asia, but their population is only about one-fortieth of that of the continent." Account for this fact.

8. Describe a journey from Omsk to Irkutsk on the Trans-Siberian railway, mentioning particularly the character of the country passed through.

9. Why is it that Russian Central Asia is a desert and Verkhoyansk the coldest place in the world?

10. Draw temperature and rainfall curves for each of these places using the same graph paper:—

	T. & R.	J	F	M	A	M	J	J	A	S	O	N	D	Year.
Omsk	T	0	2	15	35	57	65	70	70	53	38	20	8	
	R		—	—	-	1	2	2	2	1	1			9
Okhotsk	T	-12	-8	10	21	35	50	55	58	45	23	6	8	
	R	—	—	—		1	2	2	2	2	1	1	1	12

CHAPTER XIX.

THE MEDITERRANEAN REGION, OR LAND OF THE FIVE SEAS.

Recent Territorial Changes. The Mediterranean region, which occupies a central position in the land mass of the Old World, stretches from the Mediterranean Sea on the west to the Plateau of Iran on the east, and from the Caucasus on the north to the outskirts of Arabia on the south. As it is bordered by the Caspian, Black, Mediterranean and Red Seas and the Persian Gulf, it is sometimes called the "Land of the Few Seas." Almost the whole of it belonged before the Great War to the Turkish Empire. It is now split up as follows:—

(1) The Socialist Soviet Republic of Transcaucasia.

(2) Asia Minor, which may be called Turkey in Asia, as it is Turkey's only Asiatic territory.

(3) Syria, recognised as an independent state administered by France under the mandate of the League of Nations.

(4) Palestine, under British administration since its conquest in 1918.

(5) Transjordan, an Arab State under the same mandate as Palestine.

(6) Iraq, or Mesopotamia, an Arab kingdom under temporary British mandate.

Taken as a whole the above areas embrace some of the most important trade-routes of ancient and modern times.

TRANSCAUCASIA.

Trans-Caucasia formerly belonged to the Russian Empire, from which it became separated in 1917 on account of a revolution in that country. It then split up into three separate Republics: Georgia, Armenia, and Azerbaijan. On March 12, 1922, the three Republics concluded an agreement whereby they formed the Trans-Caucasian Socialist Soviet Republic.

Relief. Trans-Caucasia, which lies between the Caspian Sea and the Black Sea, consists of the southern slopes of the Caucasus mountains and the Armenian plateau. The surface is therefore mountainous. It is drained chiefly by the Kur river, which falls into the Caspian Sea. The valley of the Kur is an extensive fertile plain opening on to the Caspian Sea. The Caucasus mountains consist of a series of rugged parallel ranges full of glaciers.

Climate and Products. The climate is Mediterranean, tempered by the elevation. The winter rainfall is sufficient, and vegetation is therefore luxuriant, especially on the southern slopes of the Caucasus. The Armenian plateau is much cooler and drier. There the people are chiefly engaged in the rearing of sheep and cattle. In other parts, especially in the Kur valley, fruits, tobacco cotton, and maize, are extensively grown. But the most important products are the minerals, such as petroleum, manganese, copper, iron, coal, and salt.

Chief Towns. *Tiflis* is the capital of Georgia, and carries on the old industries of silk production and bee-keeping. It stands on the road across the Caucasus through the Darial pass and is the chief centre of trade between Russia and Persia.

Baku, on the Caspian Sea, is the capital of the

Azerbaijan republic. It is the centre of the great petroleum industry.

Batum, on the Black Sea, is important for the shipping of Baku oil to all parts of Europe. Baku and Batum are connected by railway and by a petroleum pipe-line. *Poti* is a railway station and port on the Black Sea. *Tchiaturi* is important for the production of manganese; its manganese ore mines are the richest in the world. *Erivan* is the capital of Armenia, but *Erzerum* is the largest town. It lies on a busy trade-route between the Black Sea port Trebizond and Central Asia.

ASIA MINOR, OR TURKEY IN ASIA.

The old Turkish Empire, which formerly comprised a vast territory, broke up under the Great War of 1914-18. Turkey is now mainly confined to Asia Minor in Asia and Constantinople (with some adjoining territory) in Europe. It has an area of about 500,000 square miles and a population of a little over 13½ millions. While the government of the Sultan of Turkey remained at Constantinople, another government was set up at Angora in Asia Minor in 1920 under the name of the "Government of the Grand National Assembly of Turkey." In 1922 the administration of Constantinople passed into the hands of the Angora Government. In 1923 Turkey was proclaimed a Republic and Mustafa Kemal Pasha was elected first President of the Turkish Republic.

Relief and Coast-line. Asia Minor is a plateau bordered by the Pontic mountains in the north and the Taurus mountains in the south. Both these ranges run east and west. The Taurus mountains rise very abruptly from the sea-coast. In the east they bend away from the coast, leaving the fertile plain of Cilicia. The centre of Asia Minor is occupied by a steppe which contains many salt lakes. The plateau on the whole is lowest on the west, where many beautiful and fertile valleys open towards the Ægean Sea, and highest on the east where it rises to the high Armenian plateau. Both the north and the south coasts are unbroken and therefore possess few harbours. The west coast is much indented and is studded with numerous islands. These islands are the relics of the mountain chains which were once connected with those of Greece.

Climate and Products. There are two distinct natural regions: the coast lands and the interior plateau. The coast lands, being situated near the sea and in temperate latitudes, have a mild climate with abundant rainfall in winter; they are forested with evergreen trees. The valleys opening westwards are also well wooded. Here agriculture is carried on. The Mediterranean fruits, such as olives, grapes, oranges, and figs, as well as wheat, barley, tobacco, cotton and mulberry, are produced. The plateaus are dry, very hot in summer, and very cold in winter. Thus they have little vegetation beyond grass on which goats, sheep, horses, and camels are reared. The inhabitants are a nomadic and pastoral people. Wool is the most important product. The Angora goat produces a very fine silken hair, known as mohair, from which carpets are woven

Chief Towns. *Smyrna* has a fine harbour and is the chief port. Being situated between two fertile valleys opening out to the Ægean Sea, it collects and exports their produce. *Angora,* situated in the centre of the plateau, is the capital of the new Turkish republic and the starting-point of the Baghdad Railway. It has given its name to the silky-haired race of goats alluded to above.

Brusa (or *Broussa*) is famous for the manufacture of silk.

SYRIA, PALESTINE, AND TRANSJORDAN.

Syria, Palestine, and Transjordan were formerly a part of Turkey in Asia. Syria has been recognised as an independent state, to be administered by France under the League of Nations, since 1920. It is bounded by the Mediterranean on the west, by Palestine on the south, by Mesopotamia on the east, and by Turkey on the north. It comprises an area of 60,000 square miles. The population is composed mainly of Muslims and Christians.

Palestine was placed under the British mandate and is being administered by the British since its conquest in 1918. It is about 9,000 square miles in area and has a population of about 7½ lakhs, consisting of Muslims, Jews, Christians and Bahais.

Transjordan is an Arab state administered under the British mandate of Palestine by Emir Abdullah Ibn Hussain, elder brother of King Faisal of Iraq. The Hejaz Railway runs partly through this state.

Relief. These three states lie along the eastern shores of the Mediterranean Sea and consist of a plateau with a coastal plain. This plain is narrow in the north, but broadens out in the south into the plains of Sharon and Philistia, which are the most productive districts. The coastal plain is bordered by parallel ranges of mountains with a depression between them. The southern part of this depression is the Jordan valley, in which lie the fresh-water lake of Galilee (nearly 700 feet below sea-level) and the salt Dead Sea (about 1,300 feet below sea-level). This is the deepest depression on the land surface of the earth. These lakes are the floor of a rift-valley which is continued into the Red Sea and then across Africa as far as Lake Nyassa. The plateaus of Syria and Palestine slope gently towards the east and form the Syrian desert. To the east of the rift-valley of the Jordan lies Transjordan.

Climate, Products and Industries. The climate is of the Mediterranean type. In the coastal strip and on the slopes of the Lebanon rainfall is abundant, about 40 inches in the year. Here are grown fruits such as grapes, oranges, figs, olives, as well as cotton, tobacco, and wheat. The manufactures of oil and soap are two important industries based on olives. Mulberry trees are also extensively grown for the rearing of silkworms. On the dry plateaus, summers are hot and winters cold. Here sheep are reared, from the wool of which carpets are woven. Minerals are believed to be abundant, but are little worked owing to the want of good means of communication and to the disturbed condition of the country

Chief Towns. *Beirut,* the chief port of Syria, is surrounded by a fertile region. It is connected by rail with Damascus. *Damascus* is the capital of Syria. It is situated in the midst of an oasis watered by the small river Barada. It is the meeting-place of trade-routes eastward to Mesopotamia and southward to Mecca, and is one of the oldest cities in the world.

Jerusalem is the capital of Palestine and has a very central position. Being sacred, it is visited by thousands of pilgrims and tourists.

Jaffa is a port of Jerusalem, with which it is connected by rail.

IRAQ, OR MESOPOTAMIA.

Iraq, which previously formed part of the Turkish Empire, was freed from the Turks during the Great War. It was recognised as an independent state and was placed under a temporary British mandate. On December 14, 1927, a treaty was signed between Great Britain and Iraq by which the lormer recognised the latter as an independent state. The monarchy is hereditary in the family of King Faisal, who rules the country with the help of a Senate and a Chamber of Deputies.

Relief. Iraq or Mesopotamia includes all the lowlands lying between the Arabian plateau, the Syrian desert, and the coast ranges of Persia, and has an area of about 150,000 square miles. Mesopotamia means "the land between the rivers," for it consists mainly of the basins of the Euphrates and the Tigris, which are fed by the snows of the Armenian mountains. Before reaching the Persian Gulf they join, and the combined stream is then called *Shatt-al-Arab*. It is fast filling up the Persian Gulf with the mud brought down by it, with the result that its delta is being pushed onwards at the rate of 70 feet yearly.

Climate and Products. Being situated near the tropics and beyond the reach of the Indian monsoons, the climate is hot and dry. The northern parts, however, get a fair amount of rainfall in winter, and wheat, barley, tobacco, and cotton are cultivated. On the delta and in the lower valley where irrigation is rendered easy, wheat, rice, cotton, tobacco, and dates are grown. The rest of the land is a desert or semi-desert with poor pastures here and there on which nomad Arabs rear their flocks. In ancient times there was a splendid system of canals, which made the country one of the richest districts in the world.

Here flourished the famous kingdoms of Assyria and Babylon, whose capitals are now heaps of ruins. But large schemes of irrigation are now in hand and Mesopotamia, with its rich soil, may again become one of the gardens of the world. The country is believed to be rich in mineral oil resources, which are being surveyed.

Chief Towns. Even to-day most of the towns stand on the rivers. *Mosul* stands at the navigation limit of the Tigris. It is situated at a point where routes from the Mediterranean Sea to the Caspian Sea intersect. It was once noted for the fine muslin cloth which takes its name from this town. On the opposite bank of the river stand the ruins of *Nineveh,* the capital of the ancient kingdom of Assyria. *Baghdad* stands on the Tigris at the point to which river steamers can ascend, and where this river comes very close to the Euphrates. Canals already join the Tigris to the Euphrates, and these are being developed. At Baghdad a tributary from the Zagros mountains joins the Tigris. The valley of this tributary gives an easy route to *Tehran,* the capital of Persia. Baghdad is fortunate in its communications, for it also has a regular air mail service with London and Egypt, an Anglo-Indian telegraph station, and motor services with Damascus, Beirut, and Haifa. *Basra* stands on the Shatt-ul-Arab at the head of the ocean navigation. It is therefore the chief port of the country. It is noted for its delicious dates.

Baghdad Railway. Starting from *Konia* in Asia Minor, which is the terminus of the Anatolian Railway system, the Baghdad Railway runs to *Adana.* It then pierces the Taurus range to the east of the historic Cilician Gates through which once passed the armies of

Alexander the Great. It includes in this section eleven miles of tunnels and nine miles of deep cuttings. Then it reaches *Moslimie,* where the Pilgrim Railway running from Medina through Damascus and Aleppo joins it. Thence it runs to *Jerablus,* where it crosses the Euphrates: and continuing through *Ras-el-Ain, El Helif,* and *Nisibin,* it enters *Mosul.* From Mosul, following the valley of the Tigris and passing through *Samara,* it reaches *Baghdad.* From Baghdad a branch line runs to *Kut-al-Amarah,* while the main line running along the Euphrates and passing through *Hilla* finally terminates at *Basra.* Under arrangement with the Turkish Government this railway was originally built chiefly with German capital. Germany's motive in building it, though outwardly commercial, was really political, for the project was then known in Germany as B.B.B. (Berlin, Byzantium and Baghdad Railway). Certain sections of the line were completed by 1914, when the Great War broke out. The construction was coninued during the war and after it. In 1919, at the armistice with Turkey, the entire railway, including the Taurus tunnel system, passed into the hands of the British. This railway is of great strategic importance and forms part of the new overland route to India. When it is in full working order it will divert some traffic from the Suez Canal to the Persian Gulf.

Exercises.

1. "A Mediterranean region is not necessarily a region on the Mediterranean Sea." Explain this statement.

2. What do you mean by a Mediterranean climate? Illustrate your answer by examples from Asia.

3. How has the war affected Turkey with respect

to her territories in Asia? What has become of the territories in question?

4. Mesopotamia was the seat of a mighty empire in ancient times. What advantages did it possess over Arabia?

5. Give the occupations of the inhabitants of Palestine and Syria, pointing out the influence of climate and surroundings.

6. Compare the west coast of Asia Minor with the south and north coasts as regards physical features and products.

7. Estimate from the map in your Atlas the length of the Baghdad Railway from Baghdad to Basra.

8. Write short notes on the Baghdad Railway, pointing out its commercial and strategic value. What kinds of goods will it carry?

9. State the position, and account for the importance, of Baku, Smyrna, Angora, Jerusalem, Mosul, and Damascus.

10. Why does Mesopotamia import cottons and export raw cotton? Name its chief imports and exports.

CHAPTER XX.

SOUTH-WESTERN TABLELANDS AND CENTRAL PLATEAUS.

ARABIA.

Physical Features. Arabia is a vast plateau bordered by mountains in the south-west and sloping towards Mesopotamia and the Persian Gulf. There is a narrow strip of coast land on the west and on the south-east. In the centre lies the elevated plateau of Nejd. As the coast line is uniformly unbroken harbours are few.

Climate and Products. Arabia lies in the Tropic of Cancer belt of calms. As the Tropic of Cancer passes through the middle of the country it is for six months in the track of trade-winds which below from the land. This region is therefore a rainless desert with an extremely hot and dry climate, and almost void of vegetation. The range of temperature is very high. The hill district of Yemen in the south-west receives some rainfall from the summer monsoons. Being elevated and near the sea, it enjoys a warm temperate climate and produces coffee, dates, durrah, and tobacco; it is the most cultivated and populous part of Arabia. The central plateau of Nejd is a fertile oasis and is noted for dates and horses. The camel is the most important animal.

People and Government. The people, who are called Bedouins, number about 5 millions. As Arabia is mainly a desert waste, most of them lead a nomadic life. The camel, called the ship of the desert, serves them most usefully in their wanderings. Settled life is possible only on oases where, water being available, the people resort to agriculture.

The whole of Arabia except Yemen and Oman, which are independent states under the protection of the British, is at present ruled by the Wahhabi King, Abdul Aziz Ibn Saud, who is styled the King of Hejaz and Sultan of Nejd. His capital is Riyadh, which contains a large mosque, the most sacred shrine of the Wahhabis. The country, once so remote and inaccessible, is now easily reached by motor-car and aeroplane. The law of the land is administered by Kazis, who are under the control of chief Sheikhs at Riyadh and Mecca.

Chief Towns. As Arabia is mainly a barren country consisting of sand-waste and mountain wilderness, towns are few; of these *Mecca* is the most important. Being the birthplace of the Prophet Muhammad it is most sacred to the Musalmans, and is visited by thousands of pilgrims. Its port is *Jeddah.*

Medina contains the tomb of the Prophet Muhammad and is therefore a place of pilgrimage.

Yanbo is the port of Medina. It has become important on account of the opening of the Pilgrim Railway from Damascus.

Mocha is the port from which excellent coffee used to be exported; *Hodeida* has now taken its place. *Muscat* on the east coast is the capital of Oman and exports dates. *Bahrein* is an island in the Persian Gulf under British protection. It is famous for its pearl fisheries. The great fortress of *Aden* has already been referred to in chapter XVI.

PERSIA.

Relief. Geographically, Persia, Afghanistan, and Baluchistan form one plateau called the Iranian Plateau, of which Persia (or Iran) is the western part. It is bordered on the north by the Elburz mountains, which run east to join the Hindu Kush, and on the south-west by many ranges running parallel to the shores of the Persian Gulf, with broad valleys between. The eastern portion is sandy and contains the desert of Khorasan. On account of the configuration of the land and the scanty supply of water most of the rivers do not reach the ocean. They are either absorbed by the sand or fall into inland lakes. The *Karun River* is the only one that finds its way to the Shat-al-Arab.

Climate, Products and Industries. Being situated near the Tropic of Cancer belt of calms and outside the reach of the monsoon winds, and being also bordered by high mountains, Persia receives little rainfall. Most of it is a dry desert. The climate is therefore continental in character; the summers are very hot and the winters are very cold. The mountainous districts in the north have a considerable rainfall and the climate is mild. The coast lands along the Persian Gulf, being hot and damp, are unhealthy. Where water is available agriculture is carried on and the people lead a settled life. On account of the intense heat and evaporation, the system of irrigation is by means of underground canals. On the dry plateaus goats and sheep are reared, their wool being manufactured into rugs and carpets for which Persia is noted. On the lands bordering the Caspian Sea and in the river valleys cotton, tobacco, sugar, oranges, apricots, dates, rice, wheat, opium, mulberry trees, and grapes are grown. From mulberry trees and grapes respectively silk and wine are manufactured. The country is rich in minerals, such as petroleum, iron, coal, copper, manganese and borax, but they are little worked, except petroleum. From Bushire northward to Iraq there are rich oil wells, and the oil-tankers load up with petroleum at *Ahwaz* on the Karun River or at *Basra* and *Bushire*. Petroleum is by far the most important export of the country.

Commerce and Communications. The chief imports are: cotton piece goods, sugar, tea, flour, rice and spices. The principal exports are petroleum, rugs and carpets, opium, cotton, wool, raw silk and fruits. The means of communication are few and defective. Railways have made only a small beginning, but motor transport is progressing rapidly. The roads are few and bad. Transport is therefore difficult and chiefly done by camels and mules.

Government and Religion. Persia is ruled by a king who is called Shah. He rules with the help of a Cabinet and a National Assembly called the "Mejliss."

The present king is Reza Khan Pahlevi, who was selected on December 13, 1925, by the National Assembly and the crown was made hereditary in his family.

Of the population, which is estimated at 10 millions, about three-fourths are Moslems of the Shia sect. The rest are Sunni Mussalmans, Parsis, Jews, Bahais and Christians.

Chief Towns. *Teheran,* the capital of Persia, is situated at the southern base of the Elburz mountains. It is the meeting-place of several caravan routes radiating to Baghdad, Tabriz, Meshed, etc.

Isfahan, the old capital, is situated in the midst of an oasis. It manufactures carpets, for which it is noted.

Tabriz, in the north-west, is the commercial capital and the second largest city in the country; it is linked with the Russian railway system.

Meshed, in the north-east, is famed for its shawls and carpets.

Yezd, towards the centre, has a large caravan trade and is noted for silk and felts.

Shiraz contains the tombs of Hafiz and S'adi, the famous Persian poets, and is noted for its wine and rose-gardens.

Bushire and *Bandar Abbas* are seaports on the Persian Gulf.

AFGHANISTAN.

Area and Population. Afghanistan is about 700 miles long and 600 miles broad. Its area is about 250,000 square miles, or about twice that of the Punjab. Its population is about 7 millions or one-third of that of the Punjab.

Physical Features. Afghanistan forms the eastern part of the Iranian Plateau. It is crossed by great mountain-chains of which the Hindu Kush is the loftiest. Being made up of rough rugged mountains interspersed with stretches of barren land, the country is extremely difficult of access. The Kabul is the most important river; it breaks through the mountain barrier on the east and falls into the Indus. Its valley is the famous Khaibar Pass, which gives access to the interior.

Climate, Products and Industries. As Afghanistan is a high plateau shut in by the Hindu Kush mountains on the north and the Sulaiman mountains on the south and lying off the track of the ocean winds, it is dry Summers are hot and winters are extremely cold, below freezing point. The greater portion is covered with snow for several months in the year. As the rainfall is slight, agriculture is not so important as the pasturing and rearing of sheep, goats, and cattle. Cultivation everywhere demands irrigation, by the help of which wheat, rice, tobacco, cotton, and fruits are grown. Carpets from wool and coats from sheepskins are made throughout the country, especially at Herat and Kandahar. Minerals are known to exist, and surveys are in progress.

Government. Afghanistan was till recently ruled by King Amanullah Khan who succeeded his father, Amir Habibullah Khan in 1919. The country is at present in the throes of an internecine war. Bacha-i-Saquo, an upstart, has captured the government at Kabul, while Amanullah has left the country.

Commerce and Communications. The principal exports are wool, dried fruits, asafoetida, and carpets, The chief imports are tea, sugar, clothing, machines, and hardware. Although the country is undeveloped commercially, yet as it forms a buffer state between India and Russia, it is of very great importance politically. At present there are no railways, and roads are badly constructed and mostly unmetalled.

Chief Towns. *Kabul,* the capital, is a place of great strategic importance. Since it controls the Khaibar Pass, it is called the " Key to India." It stands on the Kabul River and is the centre of the trade-routes of the country.

Kandahar is the chief commercial town of the south. It is connected with Kabul by a fine road, and trades with Bombay, Bokhara, and Samarkand.

Herat, the chief town of the west, lies in the centre of a well irrigated and fertile district.

BALUCHISTAN.

Geographically, Baluchistan forms a part of the Iranian plateau. But as it is now entirely under the administration of the Government of India, it is dealt with under "India."

TIBET.

Physical Features. Tibet is a high and dry plateau cut off from the neighbouring countries by mountains. On the south and west it is shut off from India by the Himalayas and the Karakoram mountains, on the north from Turkistan by the Kuen-lun mountains, and on the east from China by its north and south ranges. It is drained by the Sampo, as the Tibetans name the upper Brahmaputra. This river is fed by the melting of the Himalayan snows and glaciers; its length is 1680 miles. See page 240 for further details of this river.

Climate and Products. The lofty Himalayas prevent the rain-bearing monsoons of the Indian Ocean from entering Tibet; therefore it is dry. Moreover, the great elevation of the plateau, over three miles, makes the winters very cold. Thus, though it is near the Tropics, it is subject to icy winds and snow-storms. Agriculture is carried on in the sheltered valley of the Sampo, where the bulk of the population lives and grows wheat, barley, and some fruits. Over the greater part of northern Tibet the people rear goats, sheep, and yaks Pasturing is the chief occupation, and wool the most important product. The yak is to the Tibetan what the reindeer is to the man of the tundra and the camel to the dweller in the desert. It supplies him with food and clothing, and serves as a beast of burden.

Gold, borax, salt, musk, and wool are exported to China and India in exchange for tea, rice, sugar, and silk. The most important routes into Tibet from India are from (1) Siliguri, near Darjeeling; (2) Almora, in the United Provinces; and (3) Simla.

Government and Religion. The head of the government is the Dalai Lama, who acts through a minister appointed from among the chief Tibetan Lamas. The prevailing religion is Lamaism, a corrupt form of Buddhism.

Chief Towns. *Lhasa,* "the forbidden city," is the capital. It is full of Buddhist monasteries, and the Dalai Lama, who is the Buddhist High Priest, lives in a huge palace-monastery there.

EASTERN OR CHINESE TURKISTAN.

Extent and Relief. The plateau of eastern Turkistan or Sin-Kiang lies between Mongolia to the north and Tibet to the south. The Kuen-lun mountains separate it from Tibet, while the Thian-Shan mountains divide it into two parts, the larger southern area of the Tarim basin and the smaller northern region of Zungaria. The Tarim is an inland river which flows into Lake Lob Nor. It is fed by the snows and glaciers of the surrounding mountains.

Climate and Products. Being situated in the centre of a huge continent, far away from the ocean and surrounded on all sides by high mountains, Eastern Turkistan is very dry. The summers are scorchingly hot, while the winters are intensely cold, much below freezing point. The greater part is a rainless desert or semi-desert, supporting a poor pastoral people.

The settled population is found only along the banks of the streams, where wheat, barley, and fruits are grown.

Chief Towns. *Kashgar,* the capital, stands on a tributary of the river Tarim. It is the meeting-place of several caravan routes. One route goes across the Pamir to Russian Turkistan in the west, another goes to China in the east, while the third runs to Yarkand and Khotan in the south. Thus it is a great trading centre.

Yarkand commands a route across the Karakoram mountains. It is the chief centre of trade with Kashmir.

Khotan is another well-known town, situated south of Yarkand. Between the Thian-Shan and the Altai mountains lies the Zungarian pass, through which trade between Siberia and northern China is carried on.

Kulja, on the river Ili, is the chief town in Zungaria.

MONGOLIA.

Relief. Mongolia is an arid plateau lying between Siberia and northern China. In the centre of the plateau lies the desert of Gobi or Shamo, 1,500 miles in length. The Khingan mountains separate it from Manchuria.

Climate and Products. The whole plateau has an extreme climate, the summers being hot and the winters cold. In the desert of Gobi the rainfall is very slight, but in the rest of the country it is sufficient for the growth of grass on which sheep, horses, cattle, and camels are reared in large numbers. The people are nomadic Mongols: they are no longer under Chinese rule, Mongolia being now a republic in alliance with Soviet Russia.

Chief Towns. In such a dry climate towns are necessarily few. *Urga*, the capital, is the most important town. It is situated on the route which starts from Peking and, passing through Kalgan, goes on to *Kiakhta* on the Siberia frontier. There is also a motor service to Kalgan.

Maimachin, on the northern border, is another town of some importance.

Exercises.

1. Why is much of Arabia rainless and void of vegetation? Why are Yemen and Nejd not so?
2. What are the chief exports of Arabia and Persia? From what ports are they despatched?
3. Describe the physical features of Persia. What effects do they have on its climate?
4. What system of irrigation is carried on in Persia, and why?
5. Camels take 30 days to reach Kerman from Bundar Abbas. Find the distance they cover daily.
6. Describe the physical features, climate and products of Afghanistan.
7. Why are Tibet and Mongolia rainless deserts? Compare them with Arabia in this respect.
8. How do the climate and surroundings of Arabia affect the character and occupations of its inhabitants?
9. What are the principal industries of Tibet and Eastern Turkistan?
10. Where are the following and why are they important?—

    Medina, Bahrein, Shiraz, Basra, Teheran, Herat, Lhasa, Yarkand, and Urga.

CHAPTER XXI.

MONSOON REGION—CHINA AND JAPAN.

The countries included in this region are China, Japan, Indo-China, and India. Of these countries China is by far the most extensive and the most populous. It is larger than India by a million square miles, and has one hundred millions more people.

China. China is a republic consisting of China proper, Manchuria, Tibet, and Eastern Turkistan. The last two, along with Mongolia, form a separate geographical unit and have therefore been considered under Central Plateaus.

China proper and Manchuria belong to the monsoon region and will now be dealt with. The civil government of Eastern Turkistan and Manchuria is now similar to that of China proper. The exact relation of Tibet to China is still unsettled.

CHINA PROPER.

Physical Features. Most of the country is elevated and even mountainous, except in the north-east, where there is a wide plain. This plain, which includes the lower courses of the rivers Peho, Hwang-ho, and Yangtse-kiang, is very fertile. The reason is that it consists of *loess* or deep yellow soil which has been brought partly by these rivers and partly by the winds that blow in summer from the Central Plateaus. The Peiho is formed by several streams that unite at Tientsin; it falls into the Gulf of Pechili.

The Hwang-ho or Yellow River, which is fed by the melting glaciers and heavy summer rains of its mountain region, is very rapid and liable to destructive floods. Hence it is called "China's sorrow." It brings down a vast quantity of sediment which is continually deposited along its bed. The result is that this bed is raised above the surrounding region and the river changes its course frequently. For these reasons this river is not fit for navigation, though very useful for irrigation purposes.

The Yangtse-kiang, the largest river in China and one of the largest in the world, is a highly useful river both for navigation and irrigation. Its basin is composed of red soil, which, being very fertile, supports a dense population. It has on its banks many of the largest towns in China. Another river, the Si-kiang, in southern China, flows through mountainous country and has rapids which make it unsuitable for navigation.

Climate and Products. The characteristic climate is of the monsoon type, that is, the summers are hot and wet, while the winters are cold and dry. But there are important sub-types. Northern China has hot summers and cold winters, central China hot summers and cool winters, and southern China hot summers and warm winters. In all three parts most of the rain falls in summer and is heavier in southern China than in northern China. Again, the elevated regions are colder and wetter than the lowlands and coastal strips. As heat and water are abundant and the land is fertile, vegetation is luxuriant. The mountains are covered with forests of oak, bamboo, and trees which yield camphor, lacquer, and cinnamon. The slopes of the hills produce tea, which is much exported to neighbouring countries. On the lowlands are cultivated rice, sugar-cane, tobacco, cotton, opium, oilseeds, wheat, barley, and indigo. China is very rich in minerals, especially coal, iron, copper, gold, salt, and China clay. The coalfields are enormous, and are believed to be the richest in the world. All these mineral resources have been greatly neglected, but the new Republican Government is now awake to their value.

Industries. As the land is fertile and the supply of water is sufficient for irrigating crops, agriculture is the chief occupation of the people. Connected with agriculture, horticulture is also a favourite pursuit and fruit trees are grown in great variety. Next to agriculture and horticulture the rearing of silk-worms is an important industry. Silk-worms are reared on the leaves of mulberry and oak trees which grow in abundance here. Silk is also woven into cloth at Canton and Shanghai. As cotton is largely grown, it is manufactured into cloth. Many cotton mills are established in the country. Similarly flour and rice mills are also found in large numbers. Another industry worth mentioning is the making of baskets and other household utensils from bamboo, which grows abundantly on the hills. Large iron works, specially at Hanyang, near Hankow, and glass factories have also been lately established.

Commerce and Communications. The chief imports of China are: machinery, cotton goods, woollen goods, metals and minerals, cigarettes and coal. The principal exports are: silk and silk goods, tea, groundnuts, raw cotton, and vegetable oils and oilseeds.

As China is mainly a mountainous country transport is difficult. Roads are bad and railways are few. The Yangtse-kiang is the chief means of communication. In some parts human beings are employed for carrying goods from one place to another.

Government and Religion. Since February 1912, China has been a Republic, with its capital at Peking. At present it is in the throes of a revolution and a second government called the Nationalist Government has been established at Nanking. Three religions are prevailing in the country, *viz.*, Confucianism, Buddhism, and Taoism. Mohammedans and Christians are also found.

Chief Towns. *Peking,* the recent capital, is the most important town in northern China. It stands at the meeting-place of routes leading to Manchuria, Siberia, Mongolia, the Shan-si coalfield, and southern China. It is also connected by rail with Hankow.

Tientsin, the port of Peking, has a larger population than the capital. It is the northern terminus of the Grand Canal, which is about 1,000 miles in length.

Singan-fu, on the Wei-ho, is a town of great historical interest. For 2,250 years it was the capital of China.

Hankow is the second largest city in China. It stands at the confluence of the Yangtse-kiang with its tributary the Han. The valley of the Han gives an easy route to the north-west. It is a great commercial centre, especially for rice, tea, and iron; large modern steel works have been recently opened in its neighbourhood, which is now the most rapidly developing region of China.

Shanghai is the chief port, standing at the mouth of the Yangtse-kiang. Being the outlet for the rich valley of this river, it exports cotton, silk, and tea. It was one of the first ports in China to be opened to foreign trade. It is liable to be silted up by the great quantities of sediment brought down by the Yangtsi-kiang, and much dredging is needed to keep the channel clear.

Nanking, one of the ancient capitals of China, is connected by rail with Shanghai and Tientsin. It is the new capital of the country under the Nationalist Government.

Hangchou, also a former capital, is the southern terminus of the Grand Canal and is connected by rail with Shanghai.

Canton, probably the most populous city of all China, is a seaport standing at the head of a very fertile delta formed by three rivers—Pei-kiang, Si-kiang, and Tung-kiang and is the natural outlet of the rich valleys of these rivers. It trades in rice, sugar, indigo, porcelain, and cotton and silk goods. A railway connects it with Kowloon, opposite Hong-kong.

Macao (Portuguese), Amoy, Foochow, and Weihaiwei (temporarily British) are other ports.

MANCHURIA.

Relief. Manchuria lies between the river Amur on the west and the Yellow Sea on the east. The western and the eastern parts consist of mountains, while the central part is lowland. The climate is exceedingly cold in winter and very hot in summer. The rainfall is in summer.

Climate and Products. As the eastern highlands meet the rain-bearing monsoons first they get more rainfall than the other parts. The eastern parts are therefore overgrown with extensive forest of cone-bearing and broad-leaved trees. The lowlands, especially the valley of the Sungari, a tributary of the Amur, produce millet, soya beans, wheat, and rice. Manchuria is rich in minerals, but they are little worked at present. From its central position the country is of growing importance, both politically and commercially.

Chief Towns. *Mukden,* the capital, is a junction of railway lines from Korea, Peking, and Port Arthur. Being the centre for the southern agricultural region, it is the chief city of Manchuria. Its coalfields supply power for its flour mills and oil mills.

Harbin stands where the Manchurian section of the Trans-Siberian Railway begins. This section is under Japanese control.

Port Arthur is the terminus of the Trans-Siberian Railway. As it is the only port in that region which remains free from ice throughout the year, it is an important commercial and naval base. Since 1905 it has been in the possession of Japan, who seized it from Russia after the latter's defeat in the Russo-Japanese war.

JAPAN.

Extent and Coast-line. The Empire of Japan, or the Land of the Rising Sun, consists mainly of five large and numerous small islands stretching from Formosa in the south to the Kurile Islands and the southern portion of Sakhalin in the north. Of these the largest and most important island is Honshiu or Hondo, whose area is greater than that of all the rest put together. They are the remains of the great mountain system lying off the east coast of Asia, of which they were once a part. The coast is highly broken and has many good harbours. Some of these harbours are being silted up by the mud brought down by the rivers.

Physical Features. The Japanese Islands consist chiefly of volcanic mountains which are a part of the great volcanic belt surrounding the Pacific Ocean. There are many active valcanoes and hot springs, and earthquakes are frequent. The most terrible and destructive earthquake in Japanese history took place in 1923. Fuji-

Yama, which is the most famous and highest peak (12,500 feet), is an extinct volcano. Two ranges of mountains enclosing a rift valley between them run throughout the entire length of Honshiu. As the surface is chiefly mountainous, lowlands are few and scattered. The largest is to the north of Tokyo, and is very densely populated. The rivers are short and rapid; they are therefore useless for transport, but can be employed to generate electricity for industrial purposes. They bring down large quantities of fertile mud, much of which is spread over the lowlands. The rest of the mud is deposited at the river-mouths, with the result that some of the harbours, *e.g*, Tokyo and Osaka, are being filled up.

Climate. As Japan forms part of the monsoon region, the climate is of the monsoon type, but there are considerable variations from north to south and from east to west. In summer the monsoon winds blow from the Pacific Ocean and therefore cause abundant rainfall, especially in the east. In winter cold winds from Siberia prevail. While crossing the Sea of Japan these pick up moisture and cause rain and snow on the west coast. Thus the rainfall is generally heavy in all parts, but is less in the west than in the east. The winters are cold, especially in the north, which is subject to the cold Kurile current, and the summers are warm and moist. On the east coast, where the cold Kurile current meets the warm Kuro Siwo, the climate is foggy. (Compare Newfoundland in this respect.)

Products. As the rainfall is heavy the mountains are covered with forests of pine, fir, beech, cedar, bamboo. mulberry, and trees producing wax, camphor, and lacquer. On the terraced slopes of the warm moist hills tea is grown. The fertile lowlands produce rice, cotton, sugar-cane, mulberry, wheat, barley, and oats. As every inch of available land is cultivated to support the dense population, there are no pastures in Japan; cattle, horses, and sheep are therefore scarce. Japan's mineral wealth consists mainly of coal and copper, but sulphur, lead, manganese, tin, antimony, petroleum, kaolin, and some iron are also found. For manufacturing purposes iron has to be imported from China.

Industries. As coal is abundant and the rivers supply cheap electricity, the power to drive machinery is readily available. From the wood-pulp supplied by the forests paper manufacture is carried on. As sulphur and wood are available, the making of matches is a flourishing industry. An abundant supply of wood also supports the toy-making industry. Porcelain is made from kaolin or china clay, and fine lacquer wares form another famous industry. As the climate is moist and favourable for cotton spinning, cotton is manufactured into cotton goods; much of the raw cotton is imported from India, China, and the United States. Silk manufacture is also carried on. The artistic bronze work for which Japan is famous is helped by the great supplies of copper. Besides manufacturing, mining, and agriculture, fishing and shipbuilding are important industries.

Commerce and Communications. The chief exports are silk and cotton goods, matches, paper, bronze, lacquer and porcelain wares, tea, copper, and toys. The most important imports are raw cotton, wheat, wool, woollen goods, rubber, chemicals and dyes, sugar, kerosene oil, metals and machinery; rice has also to be imported for the teeming population. Railways are the chief means of communication. The principal railway follows the whole length of the east coast, giving connections between all the great towns. For short distances the jinricksha, which is a two-wheeled conveyance, is much used, but is rapidly being ousted by the bicycle and the motor-car. Ship traffic is also largely employed.

Chief Towns. *Tokyo,* the capital, is the largest city, with a population of more than two millions. It carries on many industries, the chief being the modern manufacture of clothing, matches and chemicals, and the ancient crafts in ivory, bronze, and lacquer wares. It stands at the head of the Tokyo bay, but owing to the silt its harbour is accessible only for small vessels.

Yokohama, nearer the entrance to the bay, has therefore become the chief port and the centre of foreign commerce. Ships from all parts of the world may be seen in the bay of Tokyo.

Osaka, called the "Venice of Japan" owing to its canals, is the second largest city. It owes its importance to the rich lowlands situated behind it. It is the chief seat of the modern shipbuilding and cotton-spinning industries; it is, in fact, the industrial centre of the empire.

Kobe has risen to importance owing to its excellent harbour, which is superior to that of Osaka. Its chief industries are similar to those of Osaka.

Kyoto, the old capital, is the third largest city in Japan. Owing to its beautiful surroundings and its associations it has been called the "Rome of the East." It is the centre of the best silk and tea districts and is famous for its artistic productions.

Nagasaki has the finest harbour in Japan, with a fertile and productive region behind. As coal is found near, it has become an important coaling-station and a naval dockyard.

Hakodate, which has a splendid harbour with large supplies of coal near by, is the chief town of Yezo, the northern island. It is only two days' journey from Vladivostok, the terminus of the Trans-Siberian Railway, and exports sulphur, matches, fish, beans, timber, and furs.

About sixty years ago Japan was very backward. To-day she is one of the great powers of the world. The chief cause of this wonderful progress is contact with the nations of the West. The government is a limited monarchy, but the Emperor enjoys extensive powers. The chief religions are Buddhism and Shintoism. The latter is the primitive religion, and is a system of nature and hero worship, the Mikado or Emperor being regarded as a god. Absolute religious freedom exists in the country. In addition to the islands already mentioned, the Japanese Empire includes Korea, the Kwantung Peninsula (capital, Port Arthur), the Pescadores near Formosa, as well as four Pacific groups of islands formerly held by Germany (the Pelew, Caroline, Marianne and Marshall islands) and now assigned to Japan by mandate of the League of Nations.

KOREA.

Korea, or Cho-sen, was annexed by the Japanese in 1910. It is a mountainous peninsula, higher in the east than in the west. It lies between the Sea of Japan and the Yellow Sea. The rainfall, which is brought by the monsoons blowing from the Pacific, is chiefly in summer and is heavier on the east coast than on the west. The lowlands situated in the west produce rice, millets, beans, cotton, and hemp. On the drier slopes are found pastures on which sheep and cattle are reared; thus hides form one of the chief exports. Korea is rich in gold, coal, and iron, the first of which is mined in large quantities.

Seoul, the capital, is connected by rail with its port *Chemulpo.*

Chemulpo stands at the mouth of the Han, which, though frozen in winter, is a great highway of trade.

Exercises.

1. Show the relations of relief, climate, vegetation, and the distribution of population in China.

2. Account for the density of the population in the valleys of the Hwang-ho and the Yangste-kiang rivers.

3. What are the means of communications in China? Compare them with those of Japan.

4. "The Japanese islands mark the line of a former Asiatic coast." Comment on this.

5. "The Japanese claim to be the British of the East." How far is this true?

6. Why does Japan suffer so much from earthquakes? How do they affect the mode of living of her people?

7. What are the important products, industries, and exports of Japan? How are these three things related to one another?

8. Describe the climate of Japan, and account for its variations.

9. Give the situation and state the importance of the following:—

   Peking, Canton, Hankow, Shanghai, Hongkong, Mukden, Tokyo, Osaka, Kyoto, Nagasaki, Seoul, and Tientsin.

10. The Hwango-ho is sometimes called (*a*) China's Sorrow, and (*b*) the Yellow River. Give reasons, and estimate its general usefulness.

CHAPTER XXII.

INDO-CHINA AND THE EAST INDIES.

Position and Coast-line. The whole of the country lying between the South China Sea and the Bay of Bengal is called Indo-China. It is also known as the Eastern Peninsula or Farther India. The coast is high and considerably broken, so that it is long in proportion to area and has several good harbours. The Gulf of Tongking is partly enclosed by the island of Hainan, which belongs to China.

Physical Features. Most of the country is mountainous. Three distinct chains of mountains, which are a continuation of those of eastern Tibet, run from north to south. Between the eastern and the central ranges lies the vast plain of Siam and Cambodia. The central range is continued southwards through the entire length of the Malay Peninsula. The western chain is made up of Arakan Yoma and Tenasserim Yoma. The principal rivers are the Songka, or Red River, the Mekong, the Menam, the Salwin, and the Irawadi. Their upper and middle courses are rapid and useless for navigation, but large steamships can ascend the Irawadi to Bhamo, 900 miles from the sea. The rivers bring down large quantities of sediment which has formed great deltas at their mouths. The whole of Siam, Cambodia, Cochin-China and Tongking is composed of this mud, and hence these areas are very fertile. The main branches of the deltas are navigable.

Climate and Products. Being situated within the Tropics the temperature is high throughout the year. Rain is brought in summer by the monsoons blowing from the Indian Ocean and is therefore abundant. Annam also receives rain from the north-east winds which blow in winter. Thus the climate is hot and damp. With such a climate and fertile soil, vegetation is very luxuriant. The mountains are clad with dense forests of teak, rubber, and bamboo, while coffee is grown on the hills. The plains produce rice, sugar, pepper, cotton, tobacco, rubber, mulberry, and spices. Rice is the most important crop and forms the chief article of food. Both rice and teak are exported in large quantities. From silk worms which are reared on mulberry leaves silk is obtained. The chief mineral products are petroleum and rubies in Burma, tin in the Malay Peninsula, and gold in Siam.

Industries and Commerce. As the land is fertile and heat and water are abundant, agriculture is the chief industry. Next to agriculture comes the lumbering industry, that is, the felling and floating of teak trees down the rivers. These trees are sawn into logs for export. Then comes the husking and cleaning of rice in large mills. Petroleum is found in Burma; it is pumped from wells and refined for export. The making of candles from paraffin-wax is a subsidiary industry of that province. Silk-weaving is another important industry, especially in Burma. The other industries of Burma are cigar-making and wood and ivory carving. The chief exports are rice, teak, petroleum, paraffin-wax, candles, rubber, hides and skins. The principal imports are metals, machinery, railway material, provisions, and silk.

Political Divisions. Politically Indo-China comprises Tongking, Laos, Annam, Cambodia, Cochin-China, Siam, Burma, the Federated Malay States, and the Straits

Settlements. Of these Tongking, Laos, Annam, Cambodia and Cochin-China belong to France; Siam is independent: and Burma, the Federated Malay States, and the Straits Settlements belong to Britain. Of French Indo-China, only Cochin-China is directly ruled by France. The remaining provinces have native rulers under French protection. Burma is a province of India and is administered by a Governor. The Federated Malay States and the Straits Settlements together form British Malay, and occupy most of the Malay Peninsula. The former are governed on the model of a crown colony, but the British officers act in the name of the sovereigns of the States; the chief States are Perak, Selangor, and Pahang. The latter became a British crown colony in 1867, and include Singapore, Malacca, and Penang, with various islands. The non-federated Malay States, of which Johore is the chief. are also under the protection of Great Britain

Chief Towns. *Hanoi* is the capital of Tongking. As Tongking is the most fertile part of French Indo-China, Hanoi is the chief collecting and trading centre. It is situated on the Red River, about sixty miles from the sea. Formerly it stood at the mouth, but the delta has grown rapidly. It is now connected with the rich Chinese province of Yunnan by means of a railway which follows the valley of the Red River.

Haiphong is the port of entry into Tongking, and exports rice, teak, silk, and coal.

Hue is the capital of Annam. It has little industry and is dangerous for ships on account of storms.

Saigon is the chief city of French Indo-China. It has a good harbour and is connected by means of a railway with the rich Mekong valley.

Pnom Penh is the capital of Cambodia.

Bangkok, on the Menam, is the capital and chief port of Siam, which is a buffer state between Burma and French Indo-China. Its chief exports are rice and teak. A railway runs northward connecting Bangkok with Chiengmai, another important town; there is also through railway connection with Penang and Singapore. As it has numberless canals which radiate in every direction, Bangkok has been called the "Venice of the East."

Rangoon, on the Irawadi delta, is the capital and chief port of Burma. Being connected with the interior of the country by rail and river, it is the natural outlet of the produce of the rich Irawadi valley. It exports rice, teak, silk, and petroleum.

Mandalay, the chief city of Upper Burma, is the old capital. It is centrally situated and is connected by rail with Rangoon and with the tin mines of Yunnan in China.

Moulmein, lying near the mouth of the Salwin, is the second seaport of Burma. It has rice mills, and exports large quantities of rice. It is also the chief teak port of Burma, the timber being floated down the Salwin.

Akyab is the third port of Burma and is the centre of the rice trade.

Bhamo, on the Irawadi, is the terminus for steamer traffic. As it is only twenty miles from the Chinese frontier most of the trade with China passes through it.

Singapore owes its importance to its commanding position. Situated at the head of the Malacca Straits it is the junction of the great ocean routes to and from India, the Suez Canal, China, Japan, and Australia. It is therefore a very important naval, military, coaling, and wireless station, and the centre of a flourishing trade with all parts of the world.

EAST INDIES, OR THE MALAY ARCHIPELAGO.

Position and Political Divisions. The Malay Archipelago, or the East Indies, includes all the islands that lie betueen South-East Asia and Australia. With the exception of the Philippines, they lie within ten degrees on either side of the equator and are inhabited largely by the Malays. The chief of these islands are the Greater Sundas, which include Sumatra, Java, Bali, and Borneo; the Lesser Sundas which stretch in a long chain from Lombok to Timor; Celebes; the Moluccas; and the Philippines. Of these the Philippines belong to the United States of America; parts of Borneo (British North Borneo and Sarawak) are under Britain; part of Timor is Portuguese; and all the rest are in the possession of Holland, forming the Dutch East Indies.

Natural Divisions. These islands are divided into two groups by a line drawn between the islands of Bali and Lombok and thence through the Macassar Strait to the south of the Philippines. This line is known as Wallace's Line. Wallace (1823—1913) was the great naturalist who was the first to base this division on the ground that if the sea bed between Asia and Australia were raised 600 feet the islands on the Asiatic side of the line would become part of Asia, while those on the Australian side would still be surrounded by deep water. Moreover, the flora and fauna of the former group are similar to those of Asia, while those of the latter resemble the vegetation and animals of Australia. For instance, on the Asiatic side are found bamboos, palms, monkeys and tigers; on the Australian side are found eucalyptus and kauri pine trees, and kangaroos and other pouch-bearing animals.

Relief. All these islands are mountainous and contain many volcanoes, both extinct and active. Earthquakes are therefore very common.

The soil consisted originally of limestone and chalk, but now these rocks are overspread with lava and other volcanic deposits.

Climate and Products. Sumatra and Borneo are bisected by the equator, while the other islands lie very near it. The temperature is therefore very high throughout the year, but it is tempered by the surrounding ocean and the elevation of the land. As the islands all lie in the Equatorial Belt of Calms, rainfall is very heavy. It is brought by both the monsoons, the south-west and the north-east. Thus there are two rainy seasons The soil, being volcanic, is very fertile. Under such conditions of soil, temperature, and rainfall, vegetation is most luxuriant. The mountains are covered with dense forests. In the clearings are grown rubber, coffee, sugar-cane, tobacco, rice, sago, coconut, spices, and cinchona. Among the mineral products are tin in Banka and Billiton (small islands between Sumatra and Borneo), coal in Borneo and Sumatra, and petroleum in Sumatra and Java.

Java. Java is by far the most important of the Dutch possessions in the East. It contains 80 per cent. of the total population. On account of abundant rainfall and fertile soil, vegetation is so luxuriant that Java is called the "Garden of the East." The chief products are rubber, coffee, sugar, cinchona, tobacco, rice, and sago. The Dutch have greatly developed the island by constructing roads and railways and establishing tea and coffee plantations.

Batavia is the capital. It is the chief port and controls the Sunda Strait between Sumatra and Java. *Surabaya* is an important trading centre in the east.

Sumatra. Sumatra, which is separated from the Malay Peninsula by the Malacca Strait and from Java by the Sunda Strait, is of much less importance than Java. A lofty continuous chain of volcanoes runs through it from end to end. The chief river is the *Musi,* which is navigable for a considerable distance. The principal products are rice, sago, sugar-cane, camphor, rubber, tobacco, coffee, pepper, and coconuts. In minerals wealth it is richer than Java. Petroleum is found in various places. Some coal is also worked. Banka and Billiton islands furnish about one-seventh of the world's supply of tin.

Padang is the capital and the largest town.

Deli is the centre of a district where Dutch planters with the aid of Chinese labour grow excellent tobacco, which is in great demand in Europe and America.

Borneo. This island is divided politically into Dutch Borneo and British Borneo. Dutch Borneo comprises about three-fourths of the island. British Borneo is made up of *British North Borneo,* which is administered by the British North Borneo Company; *Brunei,* which is a native state under British protection; and *Sarawak,* which is also a native state, but has an Englishman as Raja, who rules under British protection. *Sandakan* and *Jesselton* in British North Borneo, and *Kuching,* the capital of Sarawak, are the chief towns. *Labuan,* an island near the north coast of Borneo, is a British possession, valuable as a cable and wireless telegraph station.

Celebes. Celebes is separated from Borneo by the Macassar Strait. Four peninsulas shoot out from the centre of the island, of which the most important is Minahassa. It is the healthiest part, not only of the island, but of the whole Archipelago, and produces coffee which is superior to that of Java.

Macassar in the south is a great trading centre and exports coffee, copra (*i.e.* sun-dried coconut kernels), and spices.

Moluccas. Moluccas, which are clustered in three groups, lie between Celebes and New Guinea. They are so noted for the production of spices, such as cloves, nutmegs, and cardamom, that they are also known as the Spice Islands.

The Lesser Sundas. They consist of a chain of islands extending from Lombok eastward to Timor. The most important products are coconuts and coffee.

The Philippines. They consist of over 7,000 islands, of which the largest and the most important are Luzon and Mindanao. Discovered in 1521 by a Portuguese navigator they were afterwards conquered by Spain and named after King Philip II. They have belonged to the United States of America since 1898 and have undergone rapid economic development from that date. As these islands are volcanic, destructive earthquakes and typhoons or cyclonic and terrific storms are very frequent. The chief products are tobacco, hemp, coconut-oil, and sugar.

Manila, on a magnificent harbour, is the capital and largest town. Here routes from Hongkong, Singapore, Australia, and America meet. It is noted for the manufacture of cigars and the extraction of coconut oil. Manila hemp is famous as a rope-making material.

Baguio is the summer capital and is connected by rail with Manila.

Exercises.

1. What is the general characteristic of the rivers of Indo-China? In what way are they useful?

2. Describe the climate of Indo-China. Give its most important vegetable products.

3. "Siam is a buffer state like Afghanistan." What do you understand by this? What other states are included in Indo-China and to whom do they belong?

4. Give the principal products and industries of Burma. Show their connection with the climate and physical features of the country.

5. What geographical conditions contribute to the importance of Singapore, Manila, and Batavia?

6. What are the chief islands comprised in the East Indies? How far are they Australian and how far Asiatic?

7. Why is Java the most densely peopled island in the whole of the East Indies?

8 Describe briefly the relief, climate, and products of the East Indies.

9. Hanoi in the 5th century was on the coast, but is now 80 miles inland. Account for this.

10. Give the situation and importance of the following:—

Bangkok, Rangoon, Mandalay, Singapore, and Padang.

PART IV—GENERAL GEOGRAPHY OF INDIA.

CHAPTER XXIII.

INDIA—PHYSICAL FEATURES, ETC.

Shape and Position. In shape India is roughly a triangle with its base to the north and its apex towards the south: it consists of a triangular peninsula and a large continental area to the north. Geographically it has an enviable position. Forming the central peninsula of southern Asia, it lies in the centre of the eastern hemisphere and at the head of the Indian Ocean, which connects the three continents of Asia, Africa, and Australia with one another. Thus it stands on the great highway of commerce between the East and the West.

Boundaries and Extent. No country in the world is better demarcated by natural boundaries than India is. On the east, west, and south it is washed by the Indian Ocean. On the north stands the lofty wall of the Himalayas which separate it from Tibet and Turkistan. On the north-east and the north-west run the Assam and Sulaiman mountains, which are respectively the eastern and western off-shoots of the Himalayas. The Sulaiman mountains contain several passes which are called the gateways of India. Through them have come in from time to time hordes of foreigners—Aryans, Huns, Turks, and Mongols. It should be noted that Burma and Baluchistan though politically part of India, are physically apart from it. The total area measures 18 lakhs of square miles. Its extreme length from north to south is 2,000 miles and its greatest breadth from east to west is 2,500 miles.

Natural Features. Within this vast territory there is every variety of natural features. "Snow-capped mountains, precipitous ravines, undulating hills, high plateaus, level plains, sandy deserts, verdant oases, mighty streams, and rich fields diversify the surface of the country. Hindustan presents beautiful plains, fields adorned with luxuriant harvests which are gathered twice yearly, and every variety of vegetation.

"India is, as it were, an epitome of the whole world. It has regions that bask beneath the brightest rays of a tropical sun, and others than which the most awful depths of the polar world are not more dreary The varying degrees of elevation produce here the same changes that arise elsewhere from the greatest difference of position on the earth's surface. Its vast plains present the double harvest, the luxuriant foliage, and even the burning deserts of the Torrid Zone, the lower heights are enriched by the fruits and grains of the temperate climate, the upper steeps are clothed with the vast pine forests of the north, while the highest pinnacles are buried beneath the perpetual snows of the Arctic Zone. We do not here, as in Africa and the Polar Regions, see Nature under one uniform aspect; on the contrary, we have to trace gradual yet complete transitions between the most opposite extremes that can exist on the surface of the same planet."

Coast and Surroundings. The coast of India is almost unbroken; in comparison with its size the country has a very short coast-line. Moreover, the coast is low and sandy, with a shallow sea and few islands near it. Hence there are very few good harbours where ships may shelter in time of storms. We may now study the coast-line in detail.

West Coast. From Karachi to near Bombay this coast is entirely low and sandy. Karachi, which stands at the northern end of the great Indus delta and beyond the reach of river-floods, is the only good harbour in this region. Since its connection with the Punjab by the North-Western Railway it has become the natural outlet of the produce of that province On account of the huge export of wheat to Europe it is called the wheat port of India. The Rann of Cutch and the Gulf of Cambay are two large inlets, but being shallow and silted up, these are useless except for small craft. *Cambay*, *Surat*, and *Broach*, formerly among the chief ports of western India, have now lost their importance

The coast south of Bombay is called the Malabar Coast It is high and rocky and somewhat broken. *Bombay*, which stands on an island of the same name, has an excellent harbour. It is both large and safe, giving perfect shelter to ships from the storms and monsoons of the Arabian Sea. Being nearer the centre of India than any other harbour it has increased greatly in importance since the construction of the railway across the Western Ghats and the opening of the Suez Canal. On account of the enormous export of cotton and the import of cotton goods it is called the cotton port of India.

Goa, belonging to Portugal, is another good harbour which is increasing in importance. *Mangalore* ships much coffee in small vessels. *Calicut*, which gives its name to calico cloth, has only an open roadstead as anchorage for ships. *Cochin*, whose difficult harbour is being improved, is next to Bombay on this coast for commerce and shipbuilding. Lying off the west coast are the Laccadive and the Maldive islands Both groups are coral islands and grow large quantities of coconuts for export.

South Coast. This coast has near it the pear-shaped island of *Ceylon*, which is separated from the mainland by the Gulf of Mannar and Palk Strait. Ceylon is a Crown colony. Thus, though it has no connection politically with India, yet geographically it forms a part of it; it is really a detached portion of the Deccan. The *Gulf of Mannar and Palk Strait* are so shallow that ships cannot pass through them, but have to go round Ceylon. In the warm shallow waters of the Gulf of Mannar pearl-fishing is carried on.

Colombo, the capital of Ceylon, has a fine artificial harbour, protected from the south-west monsoon by a great breakwater. On account of its position at the head of the Indian Ocean and at the meeting of routes from east, west, and south, it is one of the largest coaling stations in the world. Railways radiate from it to *Kandy*, the ancient capital, and to Galle, a good natural harbour. *Palk Strait* is blocked by the island of *Rameswaram*, which is an important place of pilgrimage. From it a line has been built along the reefs of Adam's Bridge, thus connecting the railways of Ceylon and India.

East Coast. This coast is much less broken and has been silted up by the sand carried by storms and sea currents. Therefore the water near it is very shallow and there are very few good harbours. *Madras* is an artificial harbour and is in constant danger of being blocked up by sand. The roadstead is so exposed to heavy surf and storms that ships cannot lie here in safety as they do in Bombay. *Pondicherry* and *Karikal*, two small ports south of Madras, belong to France. The south-eastern coast is called the Coromandel Coast.

Calcutta, which stands on the Hugli branch of the Ganges, is the chief port of India. The Ganges brings down vast quantities of mud and silt which are deposited in the estuary of the Hugli. The navigation here is therefore difficult, but as it is the natural outlet of the extremely rich region (or "hinterland") behind it, Calcutta has risen to great importance. Like Madras, it shows how a seaport with a naturally poor harbour may flourish because of the large and populous "hinterland" which it serves. Passing Calcutta we come to *Chittagong,* which is one of the best ports of India. Being connected by railway with Assam including the rich Cachar valley, it is the direct outlet for its products, jute, rice, and tea. The Burma coast is high and rocky and has already been considered. Lying far out at sea are the *Andaman* and the *Nicobar* Islands. These are the tops of a submerged ridge which was once connected with Burma The former group is used as a penal settlement for India.

Physical Features and Natural Regions. As regards its physical features, India may be divided into the following natural regions:—

1. The mountain region of the north;
2. The Indo-Gangetic Plain;
3. The Deccan Plateau;
4. The coast strips.

A detailed account of each of these regions has now to be given.

I. The Mountain Region of the North. This includes the Himalayas, the Trans-Himalayas, and their eastern and western offshoots.

The Himalayas. They are the loftiest mountain range in the world. The highest peak, Mount Everest, is 29,002 feet high. Running in a sword-like curve for 1,500 miles, they form the northern boundary of India and separate it from Tibet. They consist of three parallel ranges with a total width of about 200 miles. The inner range and the outer range open out in the west and enclose the world-renowned valley of Kashmir, which contains the Wular Lake. The outer range is here called the Pir Panjal The third range, that is, the outermost range, is not high. It forms the southern boundary of Nepal and Bhutan. In the west it ends in the Siwalik hills, which contain the valley of Dun. Along its southern slopes there is a broad belt of jungle called the Tarai, where wild animals, such as the tiger and the elephant. abound.

The Trans-Himalayas. These consist of the Hindu Kush, the Karakoram and the Kailash mountains. The first two form the northern boundary of Kashmir and the North West Frontier Province, and the third runs across the middle of Kashmir. The name Hindu Kush is often said to mean "Slayer of the Hindus," because so many Hindu traders in early times lost their lives in crossing these mountains. But more probably the name is a corruption of *Indicus Caucasus*, for to the historians of Alexander the Great the range was the "Indian Caucasus." The highest peak of the Karakoram mountains is Mount Godwin-Austen, which is 28,278 feet above the sea-level.

The Western Offshoots. These consist of (*i*) the spurs of the Hindu Kush which run in a southerly direction and mark off the valleys of the Kunar, Panjkora, and Swat rivers; (*ii*) The Sulaiman mountains; and (*iii*) the Kirthar mountains, which run almost to the sea, separating Baluchistan from Sindh. The Sulaimans end northward at Sufed Koh. They consist of parallel ranges separated by deep valleys. Their highest peak is Takht-i-Sulaiman, which is 11,500 feet in height. They contain several passes through which foreigners have invaded India from time to time. The principal passes with their military stations to guard them are (*i*) The Khyber, with Peshawar; (*ii*) the Kurram, with Kohat; (*iii*) the Tochi, with Bannu; (*iv*) the Gomal, with Dera Ismail Khan; and (*v*) the Bolan, with Quetta. Almost all of these passes have been carved out by the rivers which fall into the Indus from the west, *viz.*, the Khyber pass by the Kabul river, the Kurram pass by the Kurram river, the Tochi pass by the river Tochi, and the Gomal pass by the river Gomal. As these mountains lie beyond the reach of the monsoons, they are dry and quite bare of vegetation.

The Eastern Offshoots. The eastern offshoots of the Himalayas consist of the *Patkai, Jaintia, Khasi,* and *Lushai* Hills. As they run north and south and separate Assam from Burma, they are a very effective land boundary on this side of India. The Burmese have thus been kept apart from the Assamese, from whom they differ in many respects. These regions receive very heavy rainfall and are covered with dense tropical forests of teak, bamboo, rubber, and mulberry

Effects of the Himalayas. (*i*) As the Himalayas are a lofty wall, they check the water-laden monsoons of India. They therefore receive very heavy rainfall and snowfall and thus act as a reservoir of moisture which feeds the mighty rivers of India—the Indus, the Ganges and the Brahmaputra. These rivers, being snow-fed, never run dry; throughout the year they provide the copious supply of water upon which the prosperity of India depends. Tibet, lying on the leeward side, is dry and bare of vegetation.

(*ii*) As they get heavy rainfall, their southern slopes are clad with dense forests which supply useful firewood and valuable timber. The drier parts make excellent pasture for sheep and goats, which supply fine wool.

(*iii*) They protect India from the cold dry winds of the north. Had there been no Himalayas, northern India would have been much colder than at present.

(*iv*) In summer they are colder than the plains, and therefore afford good sites for sanatoria or health-resorts, such as Simla, Darjeeling, Dalhousie, Murree, Mussoorie, Abbottabad, and Naini Tal.

(*v*) As they are very high and consist of several ranges rising one behind the other, they form a formidable barrier to communication, whether for friends or for enemies. To realise this we have only to think how utterly different the Tibetans are from the Indians, and how few military stations are needed on this border.

(*vi*) In view of their size the Himalayas do not furnish large quantities of minerals, either precious or economic. Gold, iron, copper, and lead are the only minerals to be extracted so far.

(*vii*) The Himalayas are also the home of hardy and warlike mountaineers, who make excellent soldiers. The Gurkhas of Nepal and the Garhwalis of Garhwal are outstanding examples.

II. Indo-Gangetic Plain. This extensive plain lies at the foot of the Himalayas and stretches from the Sulaiman and Kirthar mountains in the west to the Garo and Lushai hills in the east. It is watered by the Indus, the Ganges, the lower Brahmaputra, and their tributaries. They bring down huge quantities of silt which are spread every year over this plain. The whole of this region is therefore alluvial and very fertile. The soil is very deep, as the deposit is added to every year. In the east rainfall is ample, while in the west there is an excellent system of irrigation by canals. The result is that this region is very densely populated. A close network of railways is spread over the entire length.

Rivers. The Indus is the longest river of India (1,800 miles). It rises in the Kailash mountain near Lake Manasarowar in Tibet and flows in a big curve for a distance of 800 miles through mountains. At Kalabagh in the Salt Range it enters the plains. Flowing south-west for the rest of its course it breaks into a delta at Haidarabad in Sindh and falls into the Arabian Sea. It receives tributaries both from the right and from the left. Its chief tributaries from the right are the Gilgit; the Kabul with its feeders the Swat, the Panjkora, and the Kunar; the Kurram, the Tochi, and the Gomal. As the Indus flows close to the Sulaiman mountains, these tributaries are short and rapid and therefore useless for irrigation as well as navigation. But their valleys afford valuable routes across the mountains. The Gilgit valley leads to Northern Kashmir, while the valleys of the rest form routes to Afghanistan. The left tributaries are the Jhelum, the Chenab, the Ravi, the Beas, and the Sutlej. The Chenab receives the Jhelum on its right bank and the Ravi on the left, while the Sutlej takes the Beas. The Chenab and the Sutlej then meet, and the united stream is called the *Panjnad,* which joins the Indus at Mithankot. The country through which these five rivers flow is called the Punjab or "land of five waters." As these tributaries have a perennial flow of water over a level plain, they are highly useful for irrigation.

The Ganges, 1,560 miles long, is the most important river of India. Not only is it highly useful both for navigation and irrigation, but its valley is famous as the seat of an ancient and great civilization. As the soil of the valley is made of the mud brought down by its waters, it is very fertile and has for ages supported a very dense population. It is the most sacred of all the great rivers of India; from source to mouth 'Mother Ganga's' course marks holy ground. Its water is also believed to have medicinal properties. It rises in the Gangetic glacier of the Garhwal Range of the Himalayas and enters the Indo-Gangetic Plain at Hardwar. Then flowing eastward it bends round the Raj Mahal Hills and, making an extensive delta, discharges its waters into the Bay of Bengal. The chief tributaries on the left bank are the Alaknanda, Ramganga, Gumti, and Kosi. Those on the right bank are the Jumna (with its feeders the Chambal, the Sindh, the Betwa, and the Ken), the Tons and the Son. Of all these the Jumna (860 miles) is the most important tributary; it rises in the Jamnotri glacier near the source of the Ganges itself and joins that river at Allahabad. Of all the Ganges distributories the Bhagirathi or Hugli, at whose mouth Calcutta stands, is the most important. The swampy area is called the *Sundrabans*.

The Brahmaputra rises in the Kailash mountain, not far from the sources of the Indus and the Sutlej, and flows eastward through Tibet, where it is known as the Tsanpu (Sampo). Bending round the eastern end of the Himalayas, where it is known as the Dihang, it enters India. At first it flows to the south-west, then turns due south at the end of the Garo Hills and joins the Ganges near Goalanda. The Assam valley receives very heavy rain, which creates many short feeders for the Brahmaputra. It is a rapid river, but is navigable for steamers as far up as Dibrugarh in Upper Assam.

III. The Deccan Plateau. It consists of the whole of Peninsular India lying below the Tropic of Cancer. It is bounded on all three sides by mountain ranges. On the north side run the parallel ranges of the Vindhya and the Satpura mountains, separated by the valley of the Narbada. The Vindhyas end towards the east in the Kaimur and the Rajmahal Hills, while the Satpuras terminate in the Mahadeo, Amarkantak, and Chhota-Nagpur Hills. The *Western Ghats* form the western boundary and the eastern Ghats the eastern boundary of the Deccan. The former, which run from the Gulf of Cambay to Cape Comorin without a break, rise abruptly from the western coast and keep close to the sea. As they receive heavy rainfall they are covered with dense forests. The Eastern Ghats, which run parallel to the east coast, are lower and are broken up. Moreover, they do not keep close to the sea, especially in the south, where they turn to the west to meet the Western Ghats at the Nilgiri Hills.

Passes In these mountains there are certain important passes through which railway lines have been laid. The Satpuras contain the Gondwana depression, which allows the Great Indian Peninsular Railway to pass from Delhi to Bombay. The Western Ghats have two passes, the *Thal Ghat* and the *Bhor Ghat,* situated just north-east and south-east of Bombay respectively. The former allows the G.I.P. Railway to pass from Bombay to Allahabad, while through the latter the Madras Railway has been built. Just south of the Nilgiri Hills there is another depression called the *Palghat Gap;* the railway from Madras to Calicut passes through it.

Rivers. The rivers of the Deccan flow through rocky soil, in which they have cut deep channels and form rapids and cataracts. Canals are difficult to construct in this region, but water is easily stored in "tanks" or artificial lakes.

As the rivers are fed by the rains that fall on the Western Ghats, they overflow their banks in the rainy season, but during the rest of the year they run dry. The principal rivers are the following:—

(1) The *Mahanadi* (520 miles) rises south of the Amarkantak Hills and, flowing eastward, falls into the Bay of Bengal, making a delta. (2) The *Godavari* (900 miles) is the largest river of the Deccan. It rises near Nasik in the Western Ghats, flows south-east and, forming a delta, falls into the Indian Ocean. *Indravati, Wardha* and *Paniganga* are the chief tributaries. (3) The *Krishna* or *Kistna* (800 miles) also rises in the Western Ghats and flows eastward, making a delta at its mouth. The *Tangabhadra,* formed by the junction of the Tunga and the Bhadra, and the Bhima, are the chief tributaries. (4) The *Cauvery* or *Kavari* (470 miles) rises in Coorg among the Western Ghats, flows south-eastwards across Mysore, and breaks into a delta, like the other rivers mentioned above. (5) The *Narbada* (800 miles), and (6) the *Tapti* (400 miles) rise near the Amarkantak Hills and, flowing westward, fall into the Gulf of Cambay. As they form no deltas, they are navigable by small ships for about 100 miles from their mouths.

IV. The Coast Strips. The western coast strip extends from the Gulf of Cambay in the north to Cape Comorin in the south, and from the Western Ghats in the east to the sea on the west. It is about 40 miles broad and is made up of the mud brought down by the short rapid rivers from the Western Ghats. It is therefore very fertile. The northern part is called the Konkan, and the southern one is known as the Malabar.

The eastern coast strip stretches from the delta of the Ganges to Cape Comorin and lies between the Eastern Ghats and the Bay of Bengal. It is much wider, especially in the south, than the western strip, and is called the *Carnatic.* The whole coast is called the Coromandel coast. It contains several deltas formed by the Mahanadi, Godavari, Krishna and Kavari, and is very fertile.

Lakes. India has only two fresh-water lakes of any importance—*Wular* in Kashmir and *Kolair* in the Deccan. Among the salt lakes *Sambhar* in Rajputana and *Chilka* and *Palicat* on the east coast are the best known.

Exercises.

1. How does India occupy a favourable geographical position? Did she derive the same benefit from it some five centuries ago as she does now?
2. What kind of coast does India have? Why are there so few harbours in such a large country?
3. Divide India into its natural regions, giving a brief description of each.
4. Why has India been invaded often from the north-west? What precautions have now been taken to guard against such invasions in future?
5. What is the effect of the Himalayas on (*a*) India, (*b*) Tibet?
6. Describe a coasting voyage from Karachi to Calcutta.
7. Why is the Indo-Gangetic plain so fertile?
8. Compare and contrast the chief rivers of the Deccan with those of the Indo-Gangetic plain.
9. In what way does the east coast differ from the west coast?
10. Name the passes of the Western Ghats and estimate their value.

CHAPTER XXIV.

INDIA—CLIMATE.

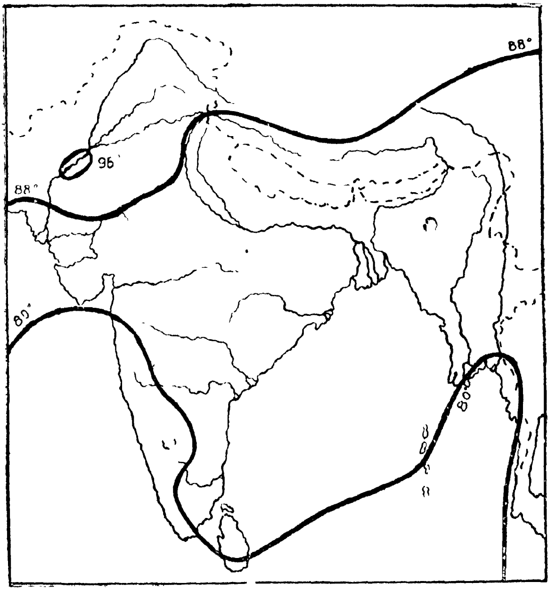
India is a vast country which extends over 40 degrees of longitude and 30 degrees of latitude. It is therefore rather a continent than a country. In such an extensive area there cannot be one uniform climate. Different parts have different climates, ranging from extremely hot to very cold, and from excessively wet to quite dry. As the Tropic of Cancer passes through the middle of it, the greater part of the country lies within the Tropics and the rest of it is sub-tropical. Hence on the whole the climate of India is hot. Each of the following six factors of climate has a great effect on the climate of the country:

(1) *Latitude.* Places near the equator are hotter than places farther north. Bombay is hotter than Karachi.

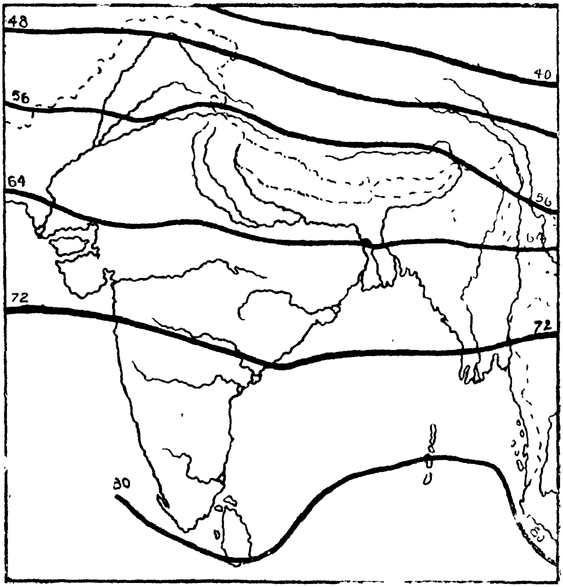
(2) *Altitude.* Places on the plains are hotter than places on mountains or tablelands. Lahore is hotter than Simla.

(3) *Nearness to Sea.* As the sea is the great equalizer of temperature, places near the sea have a more equable climate than those situated inland. Calcutta is cooler in summer and warmer in winter than Nagpur.

(4) *Nature of the soil.* Sand, unlike water, is heated very quickly and cools very quickly. Thus Jacobabad is much hotter by day and colder by night than Allahabad.



Map of India showing Summer Temperature.



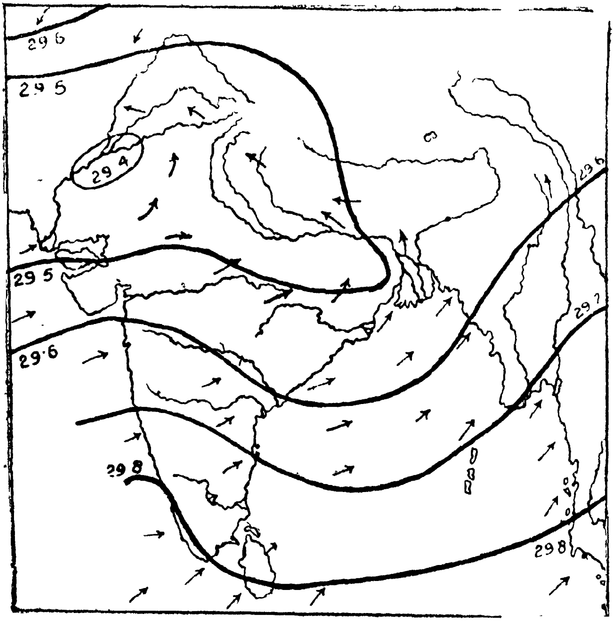
Map of India showing Winter Temperature.

(5) *Direction of the mountain ranges.* The Himalayas prevent the cold winds of the north from reaching India and the moist winds of the Indian Ocean from passing out of India. Again, the Western Ghats, running from north to south, get much more rain than the Satpura mountains or the Aravali Hills, which run in another direction. Poona is therefore much wetter than Udaipur.

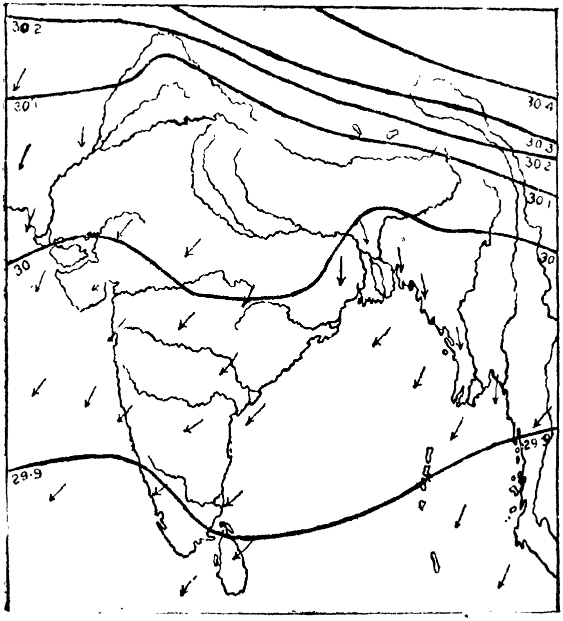
(6) *Direction of the winds.* Of all factors the winds in India have the greatest effect on the climate of the country. Here they are known as the monsoons, which we shall now study in detail.

THE MONSOONS.

1. **South-West or Summer Monsoon.** Looking at the temperature map of India for Summer we find that the north-west of India is *extremely* **hot,** while the rest of the Indo-Gangetic plain is *very* hot. This high temperature is due to the sun being in the northern hemisphere in summer, when its rays fall perpendicularly near the Tropic of Cancer. The heated land of this region heats the air above it, which then expands, rises, and decreases the pressure. The pressure map for Summer shows that the whole of the Indo-Gangetic plain is under low pressure. The map also shows that the pressure over the Indian Ocean is high, because it is comparatively cool and the air above it is colder and heavier. Thus the wind blows from the Indian Ocean where there is high pressure to the heated plains of India where there is low pressure. This wind is called the *Summer Monsoon.* It is in reality nothing but the south-east trade winds which, on account of the moving of the Doldrums as far north as northern India, have crossed the equator, and turned



Map of India showing Summar Pressure.



Map of India showing Winter Pressure.

to their right in accordance with Ferrel's Law. On account of its south-west direction this monsoon is also known as the South-West Monsoon, and blows from June to September.

Effect of the Summer Monsoon. As it blows over thousands of miles of sea water it is laden with moisture. Almost the whole of this moisture falls in the form of rain, upon which the prosperity of India depends.

This monsoon has two branches: the Arabian Sea Branch and the Bay of Bengal Branch.

The Arabian Sea Branch. This branch is subdivided into three branches:—

(*a*) As it comes rushing up from the south-west it strikes the Western Ghats with full force, and gives there an annual rainfall of over 100 inches. While passing over these mountains, it is deprived of much of its moisture, and consequently the Deccan, which is situated on the leeward side of the Western Ghats, gets a rainfall of only 25 inches and the Eastern Coast strip gets even less.

(*b*) A part of this monsoon runs through the funnel-like passage made by the Satpura and the Vindhya mountains, strikes the Amarkantak and other hills situated at the end of these mountains, and gives there a rainfall of about 60 inches.

(*c*) Still farther north, where there is the hot flat plain of Rajputana and Sindh, another part of this monsoon passes unobstructed right up to the foot of the Himalayas, which receive a heavy rainfall like that of the Western Ghats.

The Bay of Bengal Branch. This branch also, like the Arabian Sea Branch, is divided into three parts:—
(*a*) Being full of moisture, this branch strikes the mountains of Burma and brings heavy rain to these

mountains as well as to their coast strip (*b*) A part of this branch passes over the Ganges delta and strikes the Garo, Khasi and Jaintia Hills. As the monsoon has suddenly to rise to a height of 5,000 feet at Cherrapunji, the rainfall there is 500 inches, the heaviest in the world. (*c*) Another part strikes the Himalayas and, being unable to pass beyond this lofty wall, passes up the Ganges valley and becomes in this part of India a south-east monsoon. This part of the monsoon is very important, as it gives rain to the most fertile and densely peopled part of the country. It should be remembered that as it goes towards the west, it gradually loses its moisture. Therefore there is more rain in the eastern part of the Indo-Gangetic plain than in the western part. Thus Patna receives about 45 inches of rain, Delhi 27 inches, Lahore 20 inches, and Peshawar 5 inches. Again, it brings more rain to the northern side of the Indo-Gangetic plain, especially along the foot of the Himalayas called the Tarai, than it does further south. Thus Bare lly on the north side receives 35 inches of rain, while Agra on the south side gets about 25 inches.

2. **North-East or Winter Monsoon.** Now look at the temperature map of India for Winter and observe that the north and north-west parts of the country are very cold. This is because the rays of the sun now fall there obliquely. Consequently the atmospheric pressure there is much higher than in southern India and on the Indian Ocean. Hence there is a movement of air from the north-west along the valleys of the Indus and the Ganges. Over the ocean these winds, obeying Ferrel's Law, are deflected to the right and become the north-east or winter monsoon. In fact, these winds are the North-East Trades. This monsoon blows from November to February. As it comes from the land it is not only dry,

but also drying. Only that part of it passing over the Bay of Bengal picks up some moisture, which falls as rain on the eastern coast and Ceylon. Thus Madras, which gets rain from both the south-west and the north-east monsoons, has two rainy seasons.

Change of Monsoons. At the change of the monsoons, that is, in the months of April and May, and September and October, the atmosphere is unstable. Heavy storms which take the form of cyclones rise from the Bay of Bengal and rush in a westerly direction, giving rain all the way. Moreover, they raise tidal waves which often cause great destruction on the surrounding coastal plains.

Some Important Conclusions:

(1) Practically the whole of India has three climatic seasons:—

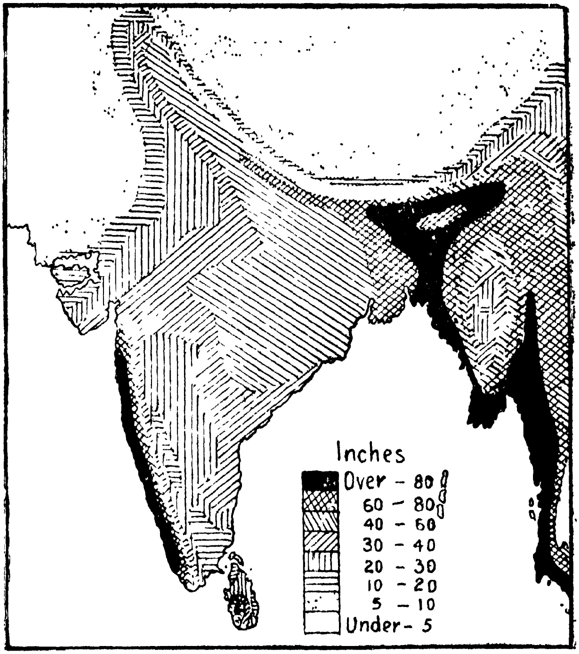
(*a*) A hot season from March to May;
(*b*) A rainy season from June to September;
(*c*) A cold season from October to February.

(2) The south-east coast, which is sheltered from the summer monsoons but open to the winter monsoons, has the following seasons:—

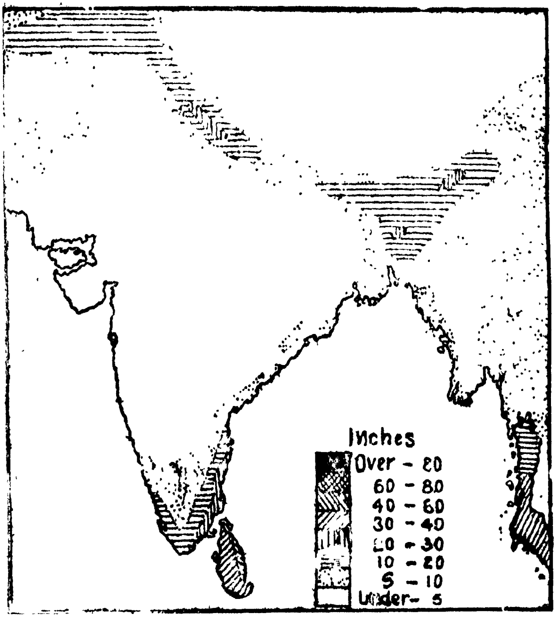
(*a*) A hot season from March to September.
(*b*) A cool season from October to February.
(c) A rainy season from October to December.

(3) Comparing the temperature map of India for Summer with that for Winter we find that the north-west, that is, the lower Indus basin and the Thar desert, is the *hottest* part of the country in Summer and the *coldest* in Winter.

(4) Comparing the pressure maps of India for Summer and Winter, we notice that the same region, *viz.*, the north-west, is a centre of high pressure in Winter and of low pressure in Summer



Map of India showing Summer Rainfall



Map of India showing Winter Rainfall.

Distribution of Rainfall. From the above account and from the rainfall maps of India, we find the following regions of heavy and scarce rainfall:—

(*a*) *Regions of heavy rainfall*:—

(1) The hills of Assam and the Brahmaputra valley;

(2) The Ganges valley from the delta up to the Jhelum;

(3) The Tarai lying at the foot of the Himalayas;

(4) The west coast from the Tapti to Cape Comorin;

(5) The east coast from the Ganges delta to Cape Comorin, since it gets rainfall from both the monsoons.

(*b*) *Regions of scarce or no rainfall*:—

(1) Baluchistan, as it lies beyond the reach of the monsoons;

(2) Western Rajputana and Sindh or the Thar desert, as this area is too level to obstruct the Arabian Sea monsoon;

(3) The Deccan, as it is shut off from the south-west monsoons by the Western Ghats;

(4) South-West Punjab, as it lies too far west to be benefited by the summer monsoons.

Winter Rains of Northern India. Northern India, especially the Punjab and the United Provinces, get some rainfall in winter. This is due to two causes:—

(1) When winter begins, the temperature of the atmosphere is lowered by the Himalayan snows and the cold winds which blow from the Iranian plateau. As cold air cannot hold all the moisture left by the summer rains much of this moisture is condensed and falls as rain.

(2) Cyclones rise from the Persian Gulf, and striking the Hindu Kush mountains they are deflected

towards the Punjab and bring rain.

Influence of Climate on the Character and Occupation of the People.

1. As the climate of India is hot and moist and the soil is fertile, agriculture has always been the chief occupation of the people.

2. The great civilizations of the ancient world are found to have arisen in warm climates. The whole modern world has been greatly influenced by the early civilization of the fertile valley of the Ganges.

3. Cultivation in India has for ages depended on the monsoon rains. If these fail crops also fail and the country is faced with famine, a disaster which calls forth the virtues of patience and fortitude and charitableness. Their dependence upon external nature and the powers that control it has helped to develop the characteristic customs and beliefs of the Indian peoples.

4. Under easy conditions of life in warm climates individuals mature early, the increase of population tends to be very rapid, and fertile regions become densely populated. Thus the Indo-Gangetic plain has an average of 400 persons to the square mile.

5. No general statement can be safely applied to the whole of India, but it may be said that the union of strength with courage is more common in the cooler north than in the warmer south. Yet a marked capacity for physical endurance is found almost everywhere.

6. The abundance and variety of natural products, and the desire to make the most of these by patient labour, have given rise to the numerous handicrafts for which India has long been famous. Skill in such crafts has been greatly developed by the system of occupational castes.

Exercises.

1. Describe the climate of India, showing the effect of each of its factors.

2. "India has a tropical climate." Criticize this statement.

3. Explain clearly how India has most of its rain in summer.

4. Account for the fact that Western Rajputana and Sindh are deserts.

5. How is the Summer Monsoon caused? Show its effect upon the prosperity of India.

6. Why is the north-west of India the hottest part of the country in July and the coldest in January?

7. Which parts of India receive the heaviest rainfall and which the least?

8. Compare the rainfall on the east coast with that on the west coast as regards (*a*) season, (*b*) amount, and (*c*) direction of the winds.

9. The Deccan plateau slopes gradually downwards from the Western Ghats to the Eastern Ghats. What differences, climatic or otherwise, would you find if the direction of the slope were reversed?

10. Explain clearly how North-Western India receives rain in winter.

11. How does the climate of India influence the character and occupations of the people?

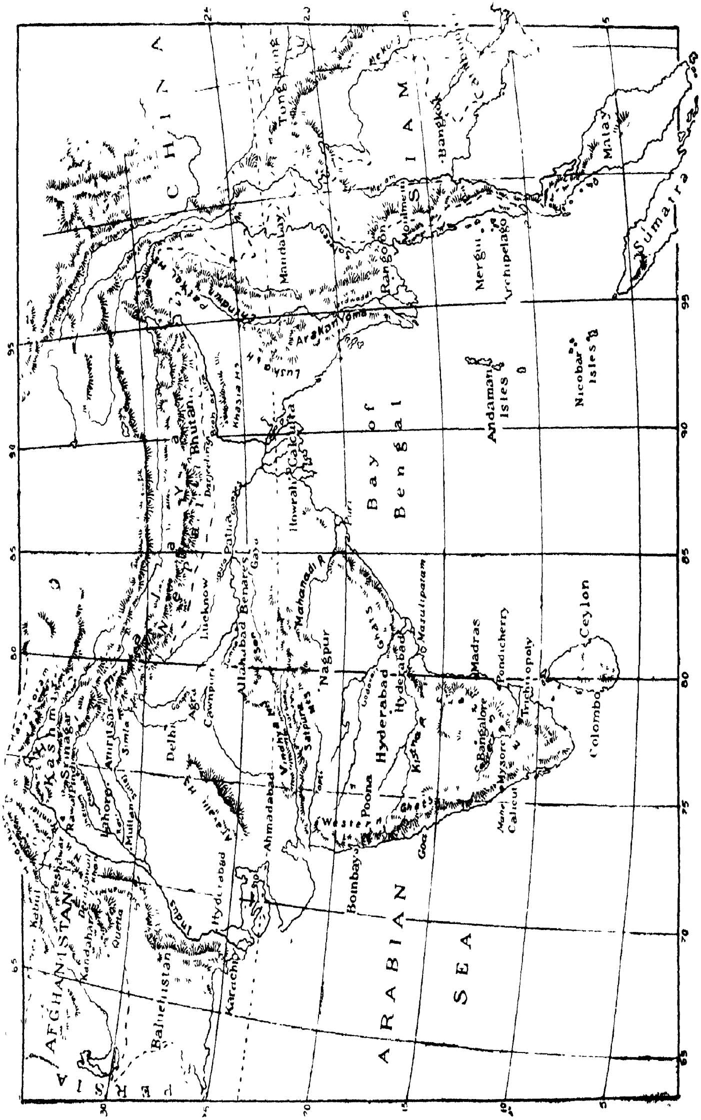
12. What kind of weather is observed towards the end and the beginning of winter?

13. Compare Sindh and Bengal as regards climate and rainfall.

14. Why is Lahore hotter in summer and colder in winter than Bombay?

15.

Place	T. & R.	J	F	M	A	M	J	J	A	S	O	N	D	Year.
Karachi	Temp.	65	68	76	80	85	87	84	82	82	80	72	67	77 (av.)
	Rain.	0·6	0·3	0·2	0·2	0·1	0·2	3·1	1·8	0·9	0·1	0·1	0·2	7·8
Bombay	Temp.	74	75	79	82	85	83	81	80	81	80	80	76	80 (av.)
	Rain.	0·1	—	—	—	0·5	20·8	24·7	15·1	10·8	1·8	0·5	0·1	74·4
Madras	Temp.	76	77	81	85	87	88	86	85	84	81	78	76	82 (av.)
	Rain.	1·0	0·3	0·4	0·6	2·2	2·1	3·8	4·4	4·7	10·8	13·7	5·1	49·1


PERSIA
AFGHANISTAN
Baluchistan
Kandahar
Quetta
Kabul
Peshawar
Dera Ismail Khan
Rawal Pindi
Srinagar
Kashmir
Lahore
Amritsar
Multan
Simla
Delhi
Agra
Cawnpur
Lucknow
Allahabad
Benares
Patna
Gaya
Darjeeling
Nepal
Himalaya
Bhutan
Khasia Hs
Lushai Hs
Calcutta
Howrah
Puri
Mahanadi R.
Nagpur
Vindhya Mts
Satpura Mts
Ahmadabad
Aravalli Hs
Hyderabad
Karachi
Indus
Bombay
Poona
Western Ghats
Goa
Hyderabad
Hyderabad
Godavari
Kistna R.
Masulipatam
Eastern Ghats
Madras
Pondicherry
Bangalore
Mysore
Calicut
Trichinopoly
Ceylon
Colombo
ARABIAN SEA
Bay of Bengal
Andaman Isles
Nicobar Isles
Mergui Archipelago
Arakan Yoma
Rangoon
Moulmein
Mandalay
SIAM
Bangkok
Malay
Sumatra
Tonking
Mekong
CHINA
65
70
75
80
85
90
95
100
5
10
15
20
25
30

(*i*) Represent the above figures graphically, using one and the same graph paper.

(*ii*) How does the rainfall differ at these places as regards (*a*) amount, (*b*) length of rainy period, and (*c*) date of beginning of rainy period. Account for the differences by reference to their position and surroundings.

(*iii*) Which of these places has the smallest range of temperature and which the greatest? Account for this in each case.

(*iv*) "In India the hottest month is that preceding the monsoon." Corroborate this statement by reference to the above figures.

CHAPTER XXV.

INDIA—IRRIGATION.

Methods of Irrigation. With the exception of certain parts, such as Assam, Bengal, and the Western Coast strip where the rainfall is abundant, India does not get sufficient rain for the cultivation of the crops. Moreover, the rainfall is unequally distributed throughout the year, there being generally a wet season followed by a long dry period. Hence artificial irrigation becomes necessary. The irrigated area of British India is now over 40 million acres, and will reach 50 million acres in the near future. There are three principal ways in which artificial irrigation is carried out. The first method is by *wells,* water from which is raised by hand, or cattle power, or power-pumping. The second method is by means of "tanks" or artificial lakes. A dam is built across a valley to collect and store the rainfall water during the monsoon. The reservoirs thus formed vary in size from the small village tank to the monumental works in the Western Ghats with masonry dams up to 270 feet in height. The third method is by means of *canals,* which may be perennial or inundation. *Perennial canals* are those which are provided with headworks so that they run throughout the year. By placing some obstruction across a river which flows throughout the year the height of the water is raised so that water may be drawn into the canal irrespective of its natural level. Such are the canals of the Punjab.

Inundation canals are those which run only during the time when the rivers are in flood. As they cannot be controlled like the perennial canals, water can be admitted to them only when the natural level of the river reaches the necessary height. Such are the canals of Sindh; some also exist in the Punjab.

Distribution of Irrigation. (*a*) Canals are generally dug where a flat surface, a soft soil, and a perennial flow of water are available. It is almost impossible to dig canals in a rocky region. As snow is an inexhaustible reservoir during the dry months of the year, only the snow-fed rivers have a permanent supply of water. Hence canals are chiefly found in the Punjab, the deltas of the eastern coast strip, Sindh, and the United Provinces. Bengal, though it fulfils all the above conditions, has little need of canals because of its heavy rainfall. The *Buckingham Canal*, which runs from the mouth of the Godavari to some fifty miles south of Madras, is a salt-water canal and is used only for navigation.

(*b*) *Tanks* are found in the Deccan, the Central Provinces, and Bundelkhand. The reasons are:—

(1) The rivers are not snow-fed, and therefore run dry in the dry season. But surface rain-water during the monsoon period can be stored up at a convenient place by means of a dam.

(2) The ground is hard and rocky, and does not allow either canals or wells to be dug.

(*c*) Wells can be dug where the soil is soft and porous, and where the rainfall, though occasional, is fairly abundant. The water which goes through the permeable strata rests on an impervious bed, and can afterwards be reached by sinking a well. Wells, though almost universal throughout India, are found in large numbers in the central part of the Indo-Gangetic plain. " Between Delhi and Benares the upper stratum of the alluvial plain is riddled like a sieve with water holes or wells ten to fifty feet in depth." (Statistical Atlas of India.) The eastern portion is too rainy to need many wells.

Suitability of the Punjab for Irrigation by Canals. The Punjab is noted for its great system of irrigation by canals. Perhaps no country in the world has such an extensive network of canals as has the Punjab, where the total area at present irrigated by canals is over one crore of acres, exclusive of 700,000 acres in the Native States. This is the greatest area irrigated in any one province of India. The Punjab is well adapted for canal irrigation for the following reasons:—

(1) All the rivers are snow-fed. Snow serves as an inexhaustible reesrvoir of water during the dry months of the year. This natural storage of water never allows the rivers to run dry.

(2) The rivers do not lie far apart from one another. Being spread like the fingers of an open hand they are evenly distributed throughout the entire breadth of the province. Thus the doabs or areas lying between any two rivers are easily irrigated.

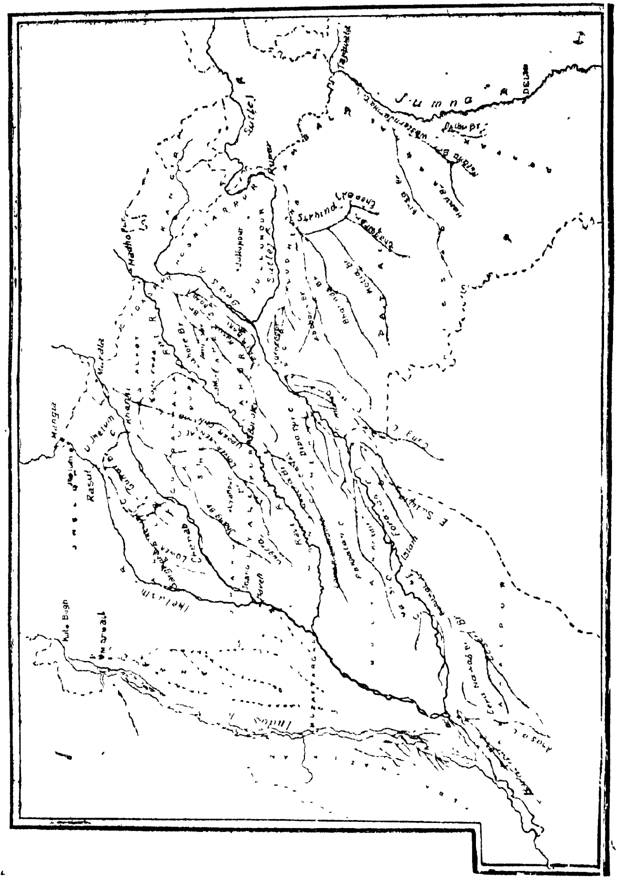
(3) Excepting the northern part, the Punjab is a flat plain with rich and soft soil. Thus canals not only can be easily and cheaply dug, but can also well repay their cost by the increased production.

Canals in Operation. The most important perennial canals in the Punjab are the following:—

1. *Western Jumna Canal.* It takes off from the River Jumna at Tajawala and irrigates the districts of Karnal, Rohtak, and Hissar.

2. *Sirhind Canal.* It takes off from the Sutlej at Rupar, and irrigates the district of Ferozpore, and the States of Patiala, Nabha, Malerkotla, and Jind.

3. *Upper Bari Doab Canal.* It takes off from the


Jumna
Delhi
Tajewala
Sutlej
Rupar
Sirhind
Madho Pur
Jullundur
Marala
Mangla
Jhelum
Rasul
Chenab
Ravi
Kala Bagh
Indus
Islam

river Ravi at Madhopur and irrigates the districts of Gurdaspur, Amritsar, and Lahore.

4. *Lower Bari Doab Canal.* It takes off from the Ravi at Balloki and irrigates the districts of Montgomery and Multan.

5. *Lower Chenab Canal.* It takes off from the Chenab at Khanki and irrigates the districts of Gujranwala, Sheikhupura and Lyallpur.

6. *Upper Chenab Canal.* It takes off from the Chenab at Marala and pours its waters into the Ravi to feed the Lower Bari Doab Canal.

7. *Upper Jhelum Canal.* It takes off from the Jhelum at Mangla and discharges itself into the Chenab. It also irrigates the Gujrat district.

8. *Lower Jhelum Canal.* It takes off from the Jhelum at Rasul and irrigates the district of Sargodha.

Triple Canal Project. As the Ravi is a small river it could not adequately supply the two canals taking off from it, *viz.*, the Upper Bari Doab Canal and the Lower Bari Doab Canal. To feed the latter, the water of the river Jhelum has been brought into the river Chenab near Khanki by means of the Upper Jhelum canal and the water of the river Chenab has been poured into the river Ravi near Balloki by means of the Upper Chenab Canal. These three canals—the Upper Jhelum, the Upper Chenab, and the Lower Bari Doab—make up what is called the *Triple Canal Project.*

Projects under Construction:—

1. *Sutlej Valley Project.* On either bank of the Sutlej, in British territory on the north and in Bahawalpur territory on the south, there are a number of inundation canals. They draw their supply from the river whenever it is in flood. Thus in a year of low rainfall little water enters the canals and in a wet year the floods cause great

damage. To remedy these two defects the Sutlej valley project has been framed. This will do three things: (1) By giving these existing canals a controlled supply of water throughout the year it will convert many of the inundation canals into perennial canals. (2) It will enable these canals to irrigate a greater area than at present, including the whole low-lying area in the river valley. (3) It will irrigate the uplands along both banks that are at present quite unirrigated. The project consists of four weirs, three on the Sutlej at Ferozepore. Suleimanke and Islam, and one on the Panjnad or the confluence of the Sutlej and the Chenab, and eleven canals taking off from them. The total area to be irrigated will be over five million acres, of which 2 millions will be in the Punjab, 2.8 millions in the Bahawalpur State, and the rest in Bikaner. As a result of this scheme about four million acres of desert will become available for cultivation. This project which has been estimated to cost Rs. 15 crores will be complete by 1933. It was sanctioned by the Secretary of State for India on 15th December 1921.

From above the Ferozepore Weir three canals will take off: two on the left bank of the Sutlej, *viz.*, the Gang Canal and the Eastern Grey Canal, and one on the right bank of the river, viz., the Dipalpur Canal. The Gang Canal, named after Sir Ganga Singh, the Maharaja of Bikaner, will irrigate the Bikaner State. A special feature of this canal is that it has been lined throughout with concrete. Though the concrete lining has considerably added to the cost, it will afford a great advantage. By stopping seepage into the subsoil, it will not only prevent the risk of water-logging the soil of the neighbouring villages, but will also afford further irrigation by the water thus saved. The Eastern Grey Canal will irrigate the part of the Ferozepore district lying between the river Sutlej and the Gang Canal, replacing the existing inundation canals known as the Grey Canals. The Dipalpur Canal will give an assured supply of water to the area at present served by the Khanwah and the Upper Sohag Inundation Canals.

From above the Suleimanke Weir, the opening ceremony of which was performed by His Excellency Sir Malcolm Hailey in April 1926, three canals also will take off: two on the left bank of the river, *viz.*, the Eastern Sadiqia Canal and the Fordwah Canal, and one on the right bank known as the Pakpattan Canal. The Eastern Sadiqia and tho Fordwah canals will irrigate the Bahawalpur State, while the Pakpattan Canal will mainly irrigate the arid tracts of the Montgomery and the Multan districts known as the *Nili Bar*.

The Islam Weir, too, will enable three canals to take off: two on the left side, *viz.*, the Bahawal Canal and the Qaimpur Canal, and one on the right side, *viz.*, the Mailsi Canal. The Mailsi Canal will irrigate the Multan district, replacing the existing Lower Sutlej Inundation Canals. The Bahawal Canal will irrigate and extend the area at present irrigated by the Bahawalpur State Inundation Canals. The Qaimpur Canal will provide irrigation to the whole area lying between the river and the Bahawal Canal.

The Panjnad Weir will enable two canals—the Abbasia Canal and the Bahawalpur Canal—to take off on the left bank of the river. Both of them will together irrigate about 17 lacs of acres of waste land in the Bahawalpur State. Of these the Abbasia Canal will be a perennial canal and the Bahawalpur Canal will be non-perennial.

2. *Lloyd (Sukkur) Barrage Project.* In Sindh there are at present numerous inundation canals which draw

their water from the lower Indus. To give them an assured supply of water and extend their scope, a barrage nearly a mile long has been constructed across the Indus near Sukkur. From above the barrage seven canals will take off, and will irrigate over 5 million acres.

This scheme takes its name from a former Governor of Bombay. It is the greatest irrigation scheme now under construction; when it is in complete working order the "Great Indian Desert" will no longer exist. The total cost of the scheme is estimated at over Rs. 18 crores.

3. *Sarda-Kichha Feeder and the Sarda-Oudh Canal.* The Sarda and the Kichha are two tributaries of the Ganges in the United Provinces. The Sarda-Kichha feeder is part of a scheme for utilizing the waters of the Sarda for the irrigation of the province of Oudh. A weir will be built across the Sarda near Tanakpur and a canal will run in a westerly direction across the Tarai to supply the existing Rohilkhand Canal. The Sarda-Oudh Canal will take off at the seventh mile of the Sarda-Kichha feeder and will run in a south-easterly direction to irrigate the north-eastern districts of Oudh.

4. *Nira Valley Development Project.* This project embraces the construction of two canals, which will take off, one on each bank, from the river Nira in the Bombay Presidency. To supply them with a sufficient amount of water a dam will be constructed at Bhagthar on one of the upper reaches of the river.

5. *Cauvery Reservoir Project.* This scheme provides for a large dam across the Cauvery (Kavari) at Metur in the Madras Presidency. By means of the reservoir thus formed, not only will the canals irrigating the Cauvery delta have an assured supply of water all the year round, but a considerable area at present unirrigated will also be brought under cultivation.

6. *Periyar Project.* The Periyar is a small river in the extreme south of India flowing from the Western Ghats into the Arabian Sea. To utilize its water, a dam has been constructed across the river and a tunnel has been cut through the Western Ghats. The water that has been led through this tunnel to irrigate the district of Madura finally flows into the river Vaigai. The Vaigai rises in the Travancore hills and falls into Palk Strait near Rameswaram.

7. *Paler Irrigation Project.* The Hyderabad State is subject to periodical famines owing to precarious and untimely rainfall. To prevent these famines the Nizam's Government has undertaken several irrigation and water storage schemes. One such undertaking is the Paler Reservoir. The Paler is a perennial river flowing through the Warrangal district. Formerly it used to flow uselessly into the sea, especially with its enormous flow of water during the monsoon floods. These wasted waters have now been held up by means of a huge earthen dam nearly 1¾ miles long. The reservoir thus formed is known as the Paler Reservoir. It is capable of storing 2,559 million cubic feet of water which will irrigate by means of canals 20,000 acres. This dam is said to be the largest earthen dam in India.

8. *The Ramganga Hydro-Electric Pumping Scheme.* In 1913 a power station was established at Bahadurabad, seven miles below Hardwar, on the Upper Ganges Canal, for the construction of the Bhimgoda Weir. In 1927 the Bahadurabad plant was supplemented and utilised to electrify the towns of Hardwar, Jawalapur, Kankhal and Roorkee. The Ramganga scheme is designed to convey hydro-electric power from an extension of the Bahadurabad power station through Roorkee Najibabad and Nagina to Moradabad in order to electrify

these towns as well as to supply irrigation in the neighbouring districts. The scheme will provide electrical energy for an urban population of two lakhs, both for domestic and industrial uses, and irrigate fifty thousand acres at present unirrigated. The scheme will also bring electrical energy within easy reach of a large rural area where it can be used for pumping water from tube-wells. The total outlay estimated is Rs. 47 lakhs.

9. *The Pykara or the Glen Morgan Power Scheme.* The Pykara is a small river which takes its rise on the Nilgiris Plateau and drops down to the plains 4,000 feet below in a series of rapids situated 16 miles to the north-west of Ootacamund. This scheme provides for the construction of a storage reservoir on the hills and a power station below them. The first stage of development is to generate about 25,000 kilowatts. This power will be carried to Ootacamund, Coimbatore, Trichinopoly and Madura, where it will be used both for domestic and industrial purposes. It will also electrify the South Indian Railway. The estimated cost is 12½ lakhs of rupees.

New Projects in the Punjab:—

(1) *The Thal Canal Project.* The districts of Mianwali, western Shahpur, and Muzaffargarh lying between the Indus and the Jhelum are quite a desert waste for want of water. Lying in the extreme north-west of India, they are out of the range of the rain-bearing summer monsoon winds. The rainfall, therefore, is very scanty, less than 10 inches a year. To irrigate this whole sandy waste, known as the *Thal,* the Thal Canal Project has been formed. This project, commanding an area of 1½ million acres, provides for the construction of a canal which will take off from the Indus at Mari opposite Kalabagh, where the river enters its plain stage

This project will not be put into operation for at least ten years, because no water is to be drawn from the Indus for the Punjab during that period.

(2) *The Haveli Project.* The Jhang district and a part of the Multan district are at present served by inundation canals taken off from the river Chenab. To give them an assured supply of water throughout the year and extend their scope, it has been proposed to construct a weir across the river Chenab near Haveli Bahadarshah, situated just below the confluence of the Chenab and the Jhelum, from which point two canals will take off. This project was originally prepared in 1916 and is now being re-estimated and the whole area is being re-surveyed. It will be taken up after the Panjnad weir has been constructed. This project will bring perennial irrigation to an area of about ¾ million acres.

(3) *The Bhakra Dam Project.* This project provides for the construction of a dam across the river Sutlej at Bhakra in the Bilaspur State. This dam will be about 500 feet high, the highest dam in the world, and the reservoir formed thereby will hold up about 11,300 million cubic feet of water. The whole scheme has been estimated to cost about Rs. 22 crores and will provide irrigation to south-east Punjab. This project will be taken up after the Sutlej Valley Project has been constructed. This project is a part of a larger project called the Sutlej Dam Project, which proposes the construction of four storage reservoirs of which the Bhakra Dam is the first.

Exercises.

1. What are the chief methods of artificial irrigation in India? In which part is each method mostly em-

ployed, and why?

2. What do you understand by perennial canals? Distinguish them from inundation canals. From which part of a river are the latter generally taken?

3. The greatest area irrigated by canals in India is the Punjab. How is the Punjab so suitable for irrigation by canals?

4. Which parts of India do not require any artificial irrigation and why?

5. Name the chief canals of the Punjab, the points where they are taken off, and the districts they irrigate.

6. "Between Delhi and Benares the upper stratum of the alluvial plain is riddled like a sieve with water holes." Account for this.

7. What is a Canal Colony? Name and describe any two of such colonies in the Punjab.

8. What irrigation projects in India are now under construction? Describe briefly any three.

9. Write short notes on the following:—

Triple Canal Scheme, Lloyd Barrage Project, Sutlej Valley Project, and Buckingham Canal.

10. In an outline map of India indicate the different systems of irrigation prevalent in different parts of the country.

CHAPTER XXVI.

INDIA—PRODUCTS AND INDUSTRIES.

I. **Vegetable Products.** Products may be classified as (1) Vegetable products, (2) Animal products, and (3) Mineral products. The chief vegetable products of India are the following:—

(*a*) **Produce of the Field.** *Rice* covers the largest acreage in India. It requires a high temperature and much moisture. It is best planted in fields that can be easily flooded to a depth of several inches at certain stages of its growth. As it is very exhausting to the soil, it is naturally most cultivated where the rivers bring annual floods and spread fertilizing silt over the low-lying lands Rice is chiefly grown in the flood plains and deltas of the Ganges, Mahanadi, Godavari, Krishna, and Kavari, and on the west coast strip. The best rice is produced in the area of which Patna is the centre. Two rice-harvests in the year are generally obtained in Bengal.

Millets and pulses cover collectively the second largest acreage. They form the chief food of the people and also serve as fodder for cattle. They are produced nearly all over the country. Generally they are confined to regions that are not suitable for rice and wheat. Jowar (great millet), bajra (spiked millet), maize and gram are the chief cereals in this group.

Wheat stands third as regards acreage. It requires a cold, moist period for its early growth and dry warm weather at the time of ripening. The soil should be a clayey loam, neither too light nor too stiff. Wheat is grown as *rabi* or winter crop, especially in the Punjab, the United Provinces, parts of the Central Provinces, and Sindh.

Cotton ranks fourth as regards acreage, but first in commercial importance. It requires a warm, moist, even climate, and a light soil containing salt and lime. The black-soil, which is retentive of moisture, suits it best. It is grown chiefly in Gujrat, Kathiawar, the Central Provinces, Berar, Sindh, the Punjab, the United Provinces, and Madras. The best cotton is grown in the black-soil of the Deccan. Sindh, *i.e.*, the area watered by the Lower Indus, will become a great cotton area on the completion of the Sukkur Barrage Scheme.

Oil-seeds. The chief oil-seeds are rape, sesamum, linseed, cotton-seed, castor-seed, and ground-nuts. They are an important product both for domestic consumption and for export. The oil extracted from them is used for food and in making soaps and candles. The oil-cake is used as food for cattle. Castor-oil is widely used as a medicine. The various oil-seeds named above are grown generally all over India, especially in Bengal, Bihar, the United Provinces, and the Punjab, with the exception of ground-nuts, which are chiefly grown in Madras.

Jute is one of India's most important products. It requires a hot damp climate. As it soon exhausts the soil, this should be rich and be renewed every year by heavy floods. Thus it is chiefly grown in the lower valleys and deltas of the Ganges and the Brahmaputra, that is, in Bengal, Assam, Cooch Behar, and parts of Bihar and Orissa. The cultivation of this plant on a large scale for manufacturing purposes is almost entirely confined to India. The fibre is used in making gunny-bags, carpets, curtains and velvets, and even for mixing with silk.

Sugar-cane requires a good soil and a hot and moist climate, but it does not need so much water as rice does. It is chiefly grown in the United Provinces, the Punjab, Bihar, and Bengal. Sugar is also obtained from palms in southern India. It should be remembered that abundant irrigation, heavy manuring, and much weeding are necessary for a heavy growth of cane. India comes next to Cuba as a producer of sugar, but to satisfy the home demand huge quantities are imported into India from Java.

Tea requires a warm, wet, and equable climate. Like the cotton-plant the tea-shrub needs a regular supply of moisture during the summer, but the ground needs to be well drained, otherwise the roots are injured. Frequent showers of rain bring out the fresh leaves. For these reasons it grows best on mountain slopes like those of Assam, Darjeeling, Dehra Dun, Kangra, and the Nilgiris.

Coffee, which is the dried fruit of a shrub, requires, like tea, a warm moist climate, but an elevation of about 3,000 feet. It cannot thrive in places where the winters are severe, nor can it stand the full force of the monsoon rains. Hence it is chiefly grown on the leeward side of the Western Ghats, that is, in Coorg, Mysore, Travancore, Cochin, and the Nilgiris.

Spices include pepper, cardamoms, cloves, cinnamon, turmeric, and chillis. Of these the first four require a warm, moist, and even climate, and are produced in Southern India, especially in the Malabar, Madras, and Travancore districts. The last two, that is, turmeric and chillis, are grown almost all over the country.

Tobacco is believed to have been introduced into India by the Portuguese in the 17th century. It requires a hot and moist climate. It is chiefly grown in Bengal, Bihar, and Southern India, particularly in the districts of Coimbatore, Salem, Trichinopoly, Madura, and Guntur For local needs it is grown almost everywhere.

Opium cannot be produced in India without a licence from Government. It requires a warm, moist climate The production is confined to certain districts of Bihar and the United Provinces, where it is known as Bengal opium, and certain states in Central India, particularly Indore, Gwalior, Bhopal, and Mewar (where it is called Mewar opium).

Indigo. Formerly India held the foremost place among the indigo-producing countries of the world, but since the successful production of artificial indigo by a chemical process the demand for natural indigo has fallen off. It require a warm, moist climate and is grown in Madras, Bihar and Orissa, the Punjab, and the United Provinces.

(*b*) **Produce of the Forest.** Forests are generally found in areas of heavy rainfall. Thus they are largely found on the Himalayas stretching from Kashmir, Kulu and Kangra right up to Assam and Burma, on the Western Ghats and on the hills of Chhota Nagpur and other hills in Central India. These forests consist chiefly of teak, sal, deodar, fir, spruce, pine, ebony and bamboo. Forests are also found in dry areas such as Sindh, Rajputana, Baluchistan and southern Punjab. The chief tree found there is *kikar* (Acacia Arabica). It has long roots to draw water from great depths and a thick bark to resist evaporation of its sap. Forests are also found along the sea coasts: such forests are known as littoral forests, the most characteristic trees of which belong to the mangrove family. The total forest area in British India is about 2¼ lakhs of square miles, or about one-fourth of the total area of the country. Of this area the Punjab contains about seven thousand square miles, or about one-fifteenth of the total area of the province. The chief forest trees are the following:—

Cinchona is a tree from the bark of which quinine is prepared. It is a native of Peru and hence its name of Peruvian bark. The first cinchona plantation in India was established in 1862. The tree is grown on the hill slopes of the Nilgiris, Coorg, Malabar, Mysore, Travancore, and Darjeeling. Owing to the value of the drug in malarial fever the Government established cinchona plantations in the Nilgiris and at Darjeeling, but most of the establishments in India are in private hands.

Rubber, like cinchona, has been introduced from South America, where it was known as caoutchouc. The name 'rubber' arose from its early use in the rubbing out of pencil marks. It requires a hot and moist climate with an evenly distributed rainfall. It is grown in Assam, and on the Malabar Coast under the Western Ghats from Mangalore to Cape Comorin.

Timber. Under timbers may be included teak, deodar, sal, shisham, bamboo, sandal, and ebony. *Teak* requires a warm climate and heavy rainfall, and mostly grows in Assam and on the Western Ghats.

Deodar, which needs a cold climate, heavy rainfall, and high altitude, grows on the Himalayas.

Sal prefers a drier climate and grows in Central India.

Shisham and *bamboo* are planted almost everywhere.

Sandal-wood is used for making small caskets and picture frames, for religious rites and ceremonies, and for extracting sandal oil. It is grown in Mysore and Coorg.

Ebony grows in Southern India, especially on the

Western Ghats.

Coco-palm. This is perhaps the most useful of all the palms. From the dried kernels of the nuts, called copra, oil is extracted; from its fibre, called coir, ropes and mats are made; while its leaves are used for roofing purposes. It requires a warm, moist climate and a sandy soil near the seashore. Thus it grows best on the coast strips and islands of southern India.

Date-palm. This tree prefers a dry climate and grows in Sindh and western Rajputana.

Importance of forests. In its forests India possesses a great national asset, for they have a great importance to the physical and economic welfare of the country. Their chief uses are the following:—

(1) Forests serve for storage of rainfall. They absorb in the sub-soil most of the rain water that falls there and give it out slowly afterwards. Thus rivers having their sources in forest areas have a constant supply of water throughout the year. They do not run dry in the dry season. Forests act not only as reservoirs of water, but also cause rainfall by producing coolness in the atmosphere. Thus they also have a great influence on the climate of our country.

(2). Forests prevent erosion and sudden floods. Where there are no forests to check and absorb the heavy downpour of rain, destructive floods are caused and the soil is eroded.

(3) Forests supply valuable timber wood, fodder and fruit.

4. They give employment to a large number of people, such as wood-cutters, sawyers, carters, carriers, raftsmen and others.

5. They provide raw materials for industries. Resin and turpentine oils are obtained from the resin of the

pine trees. Similarly paper mills, match factories, furniture factories, saw mills and turneries are all dependent upon the existence of forests.

(6) Forests are a source of income to the State. The gross forest revenues amount to over Rs. 6 crores which, deducting an expenditure of about 3½ crores, gives a net surplus ot about 3 crores a year.

2. **Animal products.** *Wool* is produced by sheep reared in the dry areas of the Punjab, Kashmir, Sindh, Baluchistan, and the Bikaner State. The wool of the Indian sheep is short-stapled and inferior to that of Europe and Australia. It is therefore largely used for the manufacture of rugs, blankets, carpets, felts, and not for clothing. The Kashmir sheep produce a silky underfleece which is used for making shawls.

Silk is produced by the silkworm. It lives upon the leaves of the mulberry tree, which requires a warm, moist climate. Silkworms are largely reared in Mysore, Bengal, Kashmir, Assam, Orissa, Chhota Nagpur, and parts of the Central Provinces. The wild silkworms of Assam and Chota Nagpur, which feed on the castor plant, produce *tassar*, a fawn-coloured silk with flat, thick fibre.

Lac is a resin secreted on the branches of tree by an insect generally known as the lac insect. From this resin are produced lac dye and lac wax Lac wax is made into shellac, which is used as a varnish and for the manufacture of boot polish, bangles, toys, etc. Lac is obtained chiefly from Chhota Nagpur, the Central Provinces, Hyderabad, Bengal, Assam, and Sindh.

Hides and Skins. The term 'hides' denotes the skins of bullocks, cows, calves, buffaloes, horses, and camels, while the term 'skins' is applied to those of sheep, goats, deer, and other wild animals. "The great cattle-rearing region is a belt extending from Cutch through eastern

Rajputana and the Punjab to Kashmir. In this belt the rainfall is not so heavy as to wash away all the saline elements that are essential to the health of cattle" (*Chisholm*). Since bullocks are used everywhere as draught animals, the number of cattle is very large. In the Punjab and Sindh, which are dry, the camel is also found.

3. **Mineral Products.** On the whole the mineral resources of India are inferior to the agricultural.

Coal is found at Raniganj in Bengal, Jherria in Bihar, Singareni in Hyderabad State, Warora in the Wardha valley of the Central Provinces, Umaria in Rewah State, Makum in Assam, Dandot in the Jhelum district of the Punjab, and other places. The total production is about 21 million tons a year, of which total about four-fifths is produced by the Raniganj and Jherria coalfields lying in the valley of the River Damodar, which flows into the Ganges delta.

Iron is rarely, if ever, found in a pure state Generally it is found combined with other minerals, forming an ore from which it is smelted. Deposits of iron ore are found at Salem in Madras, at Chanda in the Central Provinces, at Kulti near the Raniganj coalfield in Bengal, at Singhbhum in Orissa, and in Chhota Nagpur. Where these deposits do not lie near coal and limestone they are not worked for the production of iron and steel: only in Bengal and Orissa can this industry be profitably carried on, owing to the proximity of the Raniganj and Jherria coalfields.

Gold. India contributes about 2 per cent. of the world's supply of gold and occupies the seventh position among the gold-producing countries of the world. About 95 per cent. of the Indian output is obtained from the Kolar field in Mysore. Most of the remainder is found at Hutti in Hyderabad, Anantpur in Madras, and Dhalbhum in Chhota Nagpur.

Silver in a pure state is nowhere found in India, though she is its largest consumer in the world. But there is a considerable production of silver from lead-zinc deposits in Burma, where about 5,000,000 ounces are obtained annually.

Manganese. India is one of the chief sources of the world's supply of manganese, which is used for hardening steel. It is found chiefly in the Nagpur and Jubbulpore districts of the Central Provinces, the Panch Mahals district of Bombay Presidency, certain parts of Mysore State, Gangapur State of Bihar and Orissa, and the Vizagapatam and Bellary districts of the Madras Presidency. *Tungsten*, also used in hardening steel, is found in Burma.

Petroleum is found in Burma, Assam, and the Attock district of the Punjab.

Salt is obtained by evaporation from sea-water all round the coast and from the Sambhar Lake in Rajputana. Rock salt is mined in the Salt Range at Khewra in the Punjab.

Mica, which until recently was found in India more abundantly than in any other country in the world, comes largely from Bihar, Orissa, Bengal, and Madras.

II. **Industries.** The main industries of India are the following :—

1. **Agriculture.** As India has a fertile soil and a favourable climate agriculture is by far the most important occupation. About 72 per cent. of the total population is supported by agriculture. There are two agricultural seasons: the *Rabi* (winter) and *Kharif* (monsoon). Wheat, grams, sesamum, and rape are among the rabi crops; while rice, millets, cotton, sugar and many pulses

are kharif crops. Double and treble cropping, such as is found in China and Japan, is not much practised in India.

2. **Cattle and Sheep Rearing.** Cattle-rearing is closely connected with agriculture, because the bullock is used everywhere both at the plough and at the well. Buffaloes are used for these purposes in the rice fields of Bengal, and on the eastern and western coast strips. Cows and buffaloes kept for the sake of milk and butter are common.

In dry parts like the Punjab and Sindh the camel is used as a beast of burden. Sheep and goats are reared for food and clothing in the dry areas of the Punjab, Kashmir, Sindh, Baluchistan, and Bikaner State.

3. **Mining.** In view of the size and population of the country, mining is relatively unimportant. India has some rich deposits of iron ore, but not being found near coal they are not much worked. The principal minerals have already been described.

4. **Manufactures.** India has for ages been noted for its handicrafts and cottage industries. Her handmade goods found a ready sale in Europe and other foreign markets. The muslins of Dacca, the shawls of Kashmir, the filigree work of Delhi, and the figured silk of Benares and Murshidabad were greatly in demand among ladies of fashion in England and France. These handicrafts have suffered greatly from European competition and the introduction of cheap machine-made goods. Following the example of the West, India has now begun to develop manufactures on a large scale in factories. This is rendered possible by the existence of large supplies of raw material, abundant cheap labour, and ample facilities for marketing goods. At the present time the

most important manufactures are the following:—

1. *Cotton Manufacture.* At the outbreak of the Great War India ranked as fourth among the cotton manufacturing countries of the world, the first three being Great Britain, the United States and Germany. At present the total number of cotton mills in India is about 300, of which about two-thirds are in the Bombay Presidency, chiefly in Bombay city and Ahmedabad. The suitableness of Bombay for the manufacture of cotton is due to the following causes:— (*a*) Raw cotton is abundantly produced in the black-soil region lying just behind Bombay. (*b*) The climate is moist, an essential for spinning cotton so that the threads may not break. (*c*) Cheap electric power is supplied by the water from the steep Western Ghats. Other centres of the manufacture of cotton are Madras, Nagpur, and Cawnpore.

2. *Jute Manufacture* is carried on chiefly in Calcutta for the following reasons,—

(*a*) Raw Jute is abundantly available in Bengal; (*b*) coal to drive the machinery is found at Raniganj, and can be easily transported; (*c*) water transport by the Hugli is cheap and convenient. The making of gunny cloth or coarse sacking consumes half of India's jute.

3. *Iron and Steel Manufacture* is carried on at Jamshedpur in Bihar and Orissa by the Tata Iron and Steel Company, at Kulti in Bengal by the Bengal Iron and Steel Company, and at Asansol, 130 miles from Calcutta, by the Indian Iron and Steel Company. Jamshedpur lies near the Jherria coalfield and within easy reach of limestone and manganese. It was till recently a bare wild area, but has now grown into a great industrial centre. Kulti utilizes the coal of Raniganj, while Asansol is close to both the Raniganj and Jherria coalfields.

4. *Leather Manufacture.* As there is a large

number of cattle in India and hides and skins are abundantly available, leather manufacture is carried on at numerous places. The most important centre of the leather industry is Cawnpore, which manufactures harness, saddlery, and boots for the army. There are also large tanneries and leather factories at Bombay and Madras. Artistic leatherwork is a local industry in many parts of India.

5. *Woollen Manufacture.* Of the few woollen mills working in India the largest are at Cawnpore in the United Provinces and Dhariwal in the Punjab. Besides the wool produced in each of these provinces, a supply also comes from Bikaner, and from Kerman in Persia, *via* Nushki. Carpets are manufactured at Amritsar, Multan, Jaunpur, Agra, Ellore in Madras, Bikaner, Kashmir, and many other places.

The crushing of oil-seeds and the making of paper and matches are other manufactures which might be profitably developed on a large scale.

Exercises.

1. What are the chief food products of India? Name the localities where they are grown and why?

2. In what parts of India are the following cultivated? Give reasons in support of your answer:—

Oil-seeds, cotton, tobacco, rubber, and timber.

3. Name the chief animal products of India. Give the localities where each is mostly found.

4. Compare the products of the Punjab with those of Bengal. What inferences can you draw?

5. Why is Central India so suitable for the production of cotton?

6. Account for the suitability of Assam for the

production of tea.

7. What are the most important mineral products of India? Where are they found and worked?

8. Name the principal industries of India. How far is it true that India is an agricultural country?

9. Give the chief manufactures of India. What prospects of development do they have in the country? Can you suggest any important manufacturing industry not carried on at present in India?

10. Write short notes on—
Jamshedpur Iron and Steel Works, localization of industry, the cotton-mills of Bombay, the jute mills of Calcutta, and the woollen mills of Dhariwal.

CHAPTER XXVII.

INDIA—COMMERCE AND COMMUNICATIONS.

Nature of Trade. As India is mainly an agricultural country its exports are chiefly raw materials, which are manufactured into finished goods in western countries; and her imports are mainly manufactured goods from these countries.

I. **Exports.** The chief exports of India in order of value expressed in crores of rupees according to the year 1927-28, with the principal countries to which they were sent, are the following:—

1. *Jute, Raw and Manufactured* (84). Raw jute to Germany, the United Kingdom. Manufactured jute, mainly bags, to Australia, Chile, the United Kingdom, the United States, and Argentina.
2. *Cotton, Raw and Manufactured* (57). Raw cotton to the United Kingdom, Japan and Germany. Cotton piece-goods to Mesopotamia, Persia, the Straits Settlements, Ceylon, and East Africa.
3. *Food grains* (43) to Germany, the United Kingdom, and Ceylon.
4. *Oilseeds* (27) to Italy, Germany, the United Kingdom, Belgium, and Holland.
5. *Tea* (32) to the United Kingdom, Irish Free State, Russia, Canada, and Australia.
6. *Hides and Skins* (18) to Germany, Italy, the United States, the United Kingdom.
7. *Lac* (7) to the United States of America, the United Kingdom, Germany, France.

8. *Other Articles* include metals and ores, oil cakes, rubber, paraffin wax, spices, coffee, opium, teak wood, etc.

II. **Imports.** The chief imports in order of value expressed in crores of rupees according to the year 1927-28 with the principal countries from which they were sent, are the folloming:—

1. *Cotton, manufactured* (65) from the United Kingdom and Japan.

2. *Metals and Metal Manufactures* (28) from the United Kingdom, Germany, Belgium, and the United States.

3. *Machinery and Millwork* (17) from the United Kingdom, the United States and Germany.

4. *Sugar* (15) from Java, China, Hungary, Germany.

5. *Mineral oils* (10) from the United States, Borneo, and Russia, Persia.

6. *Railway plant and rolling-stock* (9) from the United Kingdom, Belgium, Germany, the United States, and Australia (mainly wooden sleepers).

7. *Motor Vehicles* (6) from the United States, the United Kingdom, Canada, Italy.

8. *Silk, raw and manufactured* (5) from China and Japan.

9. *Artificial silk* (5) from Italy and the United Kingdom.

10. *Hardware* (5) from the United Kingdom, Germany, the United States, and Japan.

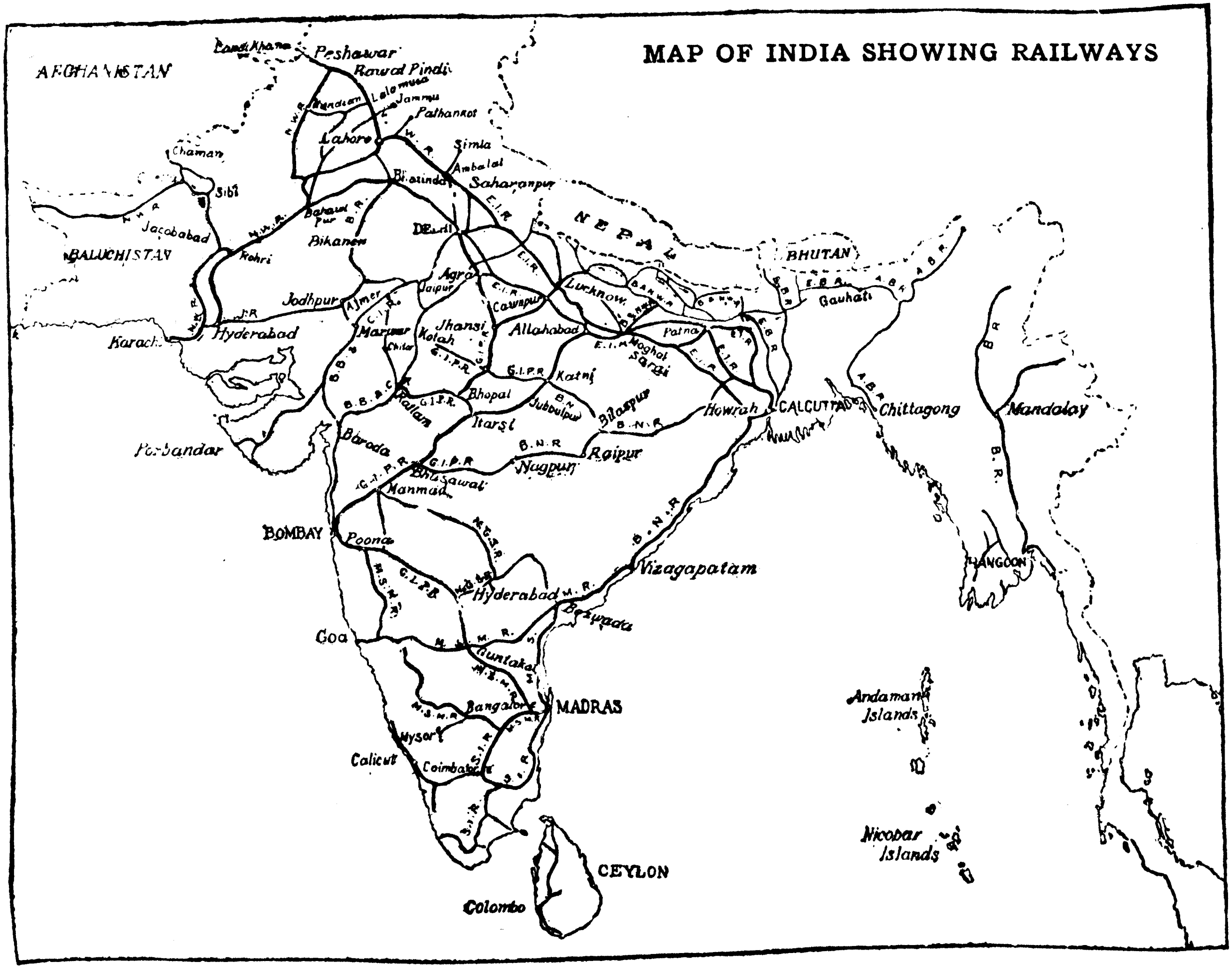
11. *Other articles* include instruments, apparatus, liquors, medicines, soap, matches, dyes, paper, pasteboard, chemicals, glassware, toys, etc. These come mainly from Germany, France, Japan, and the United Kingdom.

Trade of India according to Countries. If arrang-

ed according to countries, India's imports and exports from and to the first four countries in order of value will be as follows:—

Country	Imports, with value in crores of rupees.	Exports, with value in crores of rupees	Total trade.
1. United Kingdom.	Cotton goods, machinery, iron and steel goods, railway plant and rolling-stock, hardware and motor cars, coal and coke, etc (119).	Cotton, Jute, food grains, tea, oilseeds, hides and skins, etc. (82).	201
2. United States.	Machinery and mill work, iron and steel, railway plant, hardware, motor vehicles, etc. (20)	Jute, shellac, hides and skins, tea, and oilseeds, etc. (37)	57
3 Germany.	Dyes, iron and steel goods, hardware, chemicals, paper, toys, etc (15).	Cotton, rice, jute, oilseeds, hides and skins, etc. (33).	48
4. Japan.	Cotton goods, silk and silk goods, hardware, matches, toys, etc. (18).	Cotton, Jute, rice, pig-iron, etc. (29).	47

Trade by Land. While the bullk of India's foreign trade is sea-borne, the land frontier trade is also considerable. The chief countries with which India carries on such trade are Afghanistan, Persia, Nepal, Tibet, and the Shan States.



MAP OF INDIA SHOWING RAILWAYS

Communications. The principal means of inland communication are railways, roads, and rivers. The rivers of northern India, especially the Ganges, being slow are navigable, and considerable trade is carried on upon them. Their importance as means of navigation has much decreased owing to the construction of railways, which are a quicker, safer, and more convenient means of transport than rivers; for example, on the Indus the railway has almost superseded navigation. The *Buckingham Canal* is an inland waterway from the mouth of the Godavari to some fifty miles south of Madras.

Roads, both metalled and unmetalled, run throughout the country and connect the chief towns with one another. The Grand Trunk Road, which was begun by Sher Shah Suri about A.D. 1450, runs from Calcutta to Peshawar. A very large traffic is carried on upon these roads by country carts and other vehicles. Now that mechanical transport is becoming common in the country the roads will soon play a more important part than at present, both as competitors with, and feeders of, the railways.

Railways are the most important means of communication and transport and run throughout the country. On March 31, 1928, the total length open for traffic in India was 39,711 miles, of which 28,426 miles are owned by the Government. When we think that Great Britain and Ireland, less than 1/35 of the area of India, have 24,000 miles of railway, we realize how great is India's need of additional railways. The Indian railways have been constructed for two purposes, commercial and strategic. Strategic lines are those which connected the frontier towns with the military stations, so that military aid may be sent there in a time of necessity. The Quetta-Karachi, Trans-Indus from Kalabagh to Bannu, Kohat-Thal and Khyber railways are instances of strategic railways. The East Indian, the Great Indian Peninsular and the Bombay, Baroda and Central India Railways are examples of railways constructed for commercial purposes. A glance at the railway map will show that there is a net work of lines in the Indo-Gangetic plain, while there is no line in Western Rajputana. The reason is that the former is very fertile and thickly peopled; it therefore pays to build railways therein. But the latter is mainly a desert and is very sparsely populated. Mountain railways are difficult and expensive to construct, but the Western Ghats contain three passes through which lines have been laid. Through the Thal Ghat passes the Great Indian Peninsular Railway, through the Bhore Ghat passes the Madras and Southern Mahratta Railway, and through the Pal Ghat is laid the Madras and Calicut Railway. The chief railways of India are the following:—

1. *North-Western Railway.* A portion of this railway runs along the Indus Valley and connects Karachi with Peshawar. Another portion follows for a great distance the valley of the Sutlej and runs from Karachi to Delhi. The third portion connects Delhi with Peshawar and gives out branches which spread over the whole of the Punjab. The fourth portion connects Karachi with Quetta and Chaman, the Indian outpost on the Afghanistan frontier.

2. *East Indian Railway* connects Calcutta with Delhi. From Calcutta to Cawnpore it follows the Ganges Valley, and further on it runs along the valley of the Jumna. It has a number of branches which serve the whole of the United Provinces. Oudh and Rohilkund Railway has been amalgamated with the East Indian Railway since Ist January 1925, and has become, like the North-Western Railway, a State-worked line.

3. *Eastern Bengal Railway* starts from Calcutta and serves the whole of Bengal and part of Assam, following the valley of the Brahmputra.

4. *Assam-Bengal Railway* starts from Chittagong and, as its name indicates, connects Bengal with Assam.

5. *Bengal-Nagpur Railway* has two main branches. One connects Calcutta with Nagpur and the other runs from Calcutta to Vizagapatam along the east coast. (A sub-branch joins Bilaspur on the Calcutta-Nagpur line with Katni, which is connected on three sides with the Great Indian Peninsula Railway.)

6. *Great Indian Peninsula Railway* has become, since July 1, 1925, a State-owned and State-worked railway. It starts from Bombay and runs in a north-east direction to Itarsi in the Central Provinces. From Itarsi one line goes through Jhansi and Agra to Delhi, while another runs through Jubbulpore and Katni to Allahabad. It also connects Jhansi with Cawnpore. Another of its lines runs from Bombay in a south-eastern direction towards Madras.

7. *Bombay, Baroda and Central India Railway* also starts from Bombay and, passing along the west coast, runs through Surat and Baroda to Ratlam. From these, while the main line runs straight through Kotah to Agra, a narrow-gauge line goes off to the north-west and passing through Chitorgarh, Ajmer and Rewari reaches Delhi.

8. *Madras and Southern Mahratta Railway* consists of three lines all of which start from Madras. One line runs along the north-east coast through Bezwada to Vizagapatam. The second line goes to the north-west and, following the valley of the River Pennar, reaches Krishna on the river of the same name, where it connects with the Great Indian Peninsula Railway. The third line runs due west to Bangalore in Mysore.

9 *South Indian Railway* starts from Madras and passing through Salem and Coimbatore crosses the Western Ghats through the Palghat gap. From thence it reaches Calicut and running along the west coast finally terminates at Mangalore. Additions to this railway system are being rapidly constructed.

Lines Newly Opened or Under Construction in the Punjab and North-West Frontier Province:—

1. *Kangra Valley Railway*. This is a narrow gauge (2′-6″) line, and taking off at Pathankot it runs through the Kangra Valley to Shanon, a distance of 100 miles. It has opened up the rich Kangra Valley and made the Kulu Valley more accessible. Shanon is the site of the power station for the Mandi Hydro Electric Power Scheme.

2. *Shahdara-Narowal and Amritsar-Narowal Railways.* Both these sections are an extension of the Sialkot-Narowal branch of the North-Western Railway. They traverse highly cultivated and thickly populated areas that were in need of improved transport facilities. The latter provides a short cut between Amritsar and Sialkot.

3. *Khyber Railway*. The construction of this railway, a length of about 28 miles, was begun in November, 1920. On account of the difficult and mountainous character of the country and the hostile attitude of the people of this region, progress was very slow. It took at least five years to construct the section from Jamrud to Landikotal, a distance of only 21 miles, which was opened for traffic on 2nd November 1925. The remaining portion from Landikotal to Landi Khanna has also been completed. Besides these, several other lines, as the Sargodha-Gujrat, the Sargodha-Khushab, the Lyallpur-Jaranwala, the Panipat-Rohtak, the Chak Jhumra-Chiniot, and the Zaffarwal-Jessar Railways, are under construction and

many other schemes are under consideration.

Burma-Siam Railway Connection Project. This railway starts from Ye on the Burmese coast below Moulmien, and goes along the coast to Tavoy and Mergui. Thence it crosses the Malay Peninsula through Tenasserim to Prachaub Kirikan on the Siamese coast. There it will be connected with the Siam Railway which runs from Bangkok to Penang. This line will not only connect Burma with the highly developed Federated Malay States but will also form part of a new overland route to the Far East.

As present the Siamese mails are landed at Penang and go on to Bangkok by rail. The development of Mergui as a port and its employment as a mail route will shorten the rail-journey by over 400 miles and also the sea-journey from India by much the same distance.

Other projects include the Raipur-Vizianagram line, which will serve the new harbour at Vizagapatam; a Central India Coalfields Railway; the Kazipet-Bellarshah railway now being built by the Nizam's Government; an Indo-Burma connection through the Arakan Mountains; and the electrifications of various lines entering Bombay and Madras.

Air Routes. Provision has been made for a 5,000 miles air route which will bring India within a few days' reach of London. The flying-boats will each carry about 20 passengers. In India the routes are from Karachi to Delhi, 690 miles; Delhi to Calcutta, 815 miles; Calcutta to Rangoon, 810 miles: a total of 2,315 miles of air travel. It is also proposed to connect Karachi with Bombay.

Distribution of Population. The population of a country depends upon several factors which vary according as the country is agricultural, like India, or manu-

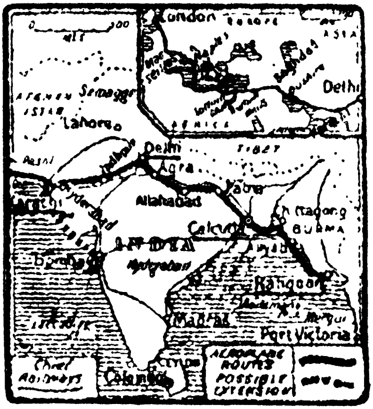


Fig. 47.—Map of India showing Air-Routes.

facturing, like England.

In an agricultural country the fertility of soil and the amount of moisture available are the first consideration, while in a manufacturing land the existence of coal and iron close together are the most important. Thus in England the population is densest in coal and iron districts; on the other hand in India the fertile parts with good rainfall or artificial irrigation are very densely peopled. Other factors which determine the density of population are:—

(*a*) *Healthy Climate;* (*b*) *Easy Communications;* (*c*) *Safety from enemies and wild animals;* (*d*) *Political peace.* It is clear therefore that the distribution of population does not depend entirely on geographical factors, except in its early stages. In its later stages, when great industries and cities have sprung up in particular localities, these often continue to grow in spite of geographical considerations.

1. **Densely Peopled Parts:—**

(*a*) *The Indo-Gangetic Plain* is the most thickly populated part of India, because it is extremely fertile and well watered. The eastern portion gets a heavy rainfall, while the western is splendidly irrigated by canals.

(*b*) *Coast Strips.* Both the west coast and the east coast strips are densely peopled. The west coast strip from the mouth of the Tapti to Cape Comorin gets a heavy rainfall. The east coast strip from the Ganges delta to Cape Comorin, though it does not get so heavy a rainfall as the west coast strip, has well watered deltas.

2. **Thinly Peopled Parts:—**

(*a*) Baluchistan, Sindh, Rajputana, and the Deccan are thinly peopled because the rainfall is insufficient for agriculture.

(*b*) *Northern Assam and the Tarai* have sparse population, because (*i*) the climate is malarious and unhealthy; (*ii*) they are covered with dense jungles; and (*iii*) they are open to the attacks of wild animals and hostile tribes.

(*c*) *The Himalayas, the Western Ghats, and Chhota Nagpur* are thinly peopled in spite of heavy rainfall, because they are mountainous and covered with thick jungle.

People. The people of India, who number about 320 millions, belong to several races, speak a great variety of languages, and profess different religions.

Races. Baluchistan and the North-West Frontier Provinces are mainly inhabited by Pathans or people belonging to the Turko-Iranian race; Punjab, Kashmir and Rajputana are occupied chiefly by the people, tall and fair-coloured, of the Aryan race. The Himalayas, Nepal and Assam are peopled by the Tibetan or Mongoloid type; while the rest of India has people containing a mixture of these and other races. The Parsis, who originally belonged to Persia, are centred chiefly in

Bombay. The Aborigines, or the Bhils, Kols, and Santhals, are the original inhabitants of India and are found scattered about Central India, in forested hills or dark jungles.

Languages. The Hindi language is spoken by 97 millions, Bengali by 49 millions, Telugu by 24 millions, Marathi by 19 millions, Tamil by 18½ millions, Punjabi by 16 millions, Rajasthani by 12½ millions, Kanarese and Oriya each by 10 millions, Gujarati by 9½ millions, Burmese by 8½ millions, and Malayalam by 7½ millions. In addition there are ten languages each spoken by more than a million people. English is the official language and the mother-tongue of more than 3 lakhs of people.

Religions. Two-thirds of the people, who number about 320 millions in all, are Hindus, including over 11 millions Buddhists, over 3 millions Sikhs and over one million Jains; over 68 millions are Muhammedans; and nearly 5 millions are Native Christians. The Hindus are split up into numerous castes and predominate in Madras, Assam, Bihar and Orissa, the United Provinces, the Central India tracts, Rajputana and Bombay. The Buddhists are almost entirely confined to Burma, where they form 85 per cent. of the population. The Sikhs are localised in the Punjab, and the Jains in Rajputana, Ajmer-Merwara and the neighbouring States. The Mohammedans form the majority in the Punjab, Sindh, the North-West Frontier Province, Baluchistan, Kashmir, and Bengal. The Native Christians are mostly found in southern India.

Exercises.

1. "The products of India are complementary to those of Britain." Explain and justify this statement.

2. How would you account for the fact that cotton is exported to Britain and cottons imported from Britain?

3. Name the principal imports and exports of India, mentioning the ports through which they are brought in or sent out.

4. Name the four countries which carry on most trade with India. What articles do they trade in and why?

5. To which countries are the following exported:—Tea, jute, wheat, cotton, and oilseeds. Account for the trade in each case.

6. From which countries are the following imported:—

Sugar, silk, cottongoods, motor cars, and railway plant. Account for the trade in each case.

7. Compare the trade with India of Japan and Germany, and of the United Kingdom and the United States. What differences do you find?

8. From the figures given in this chapter represent by diagram—

(*a*) The comparative values of the chief articles of import and export.

(*b*) The total trade with India of the principal countries.

9. Compare the amount of the land-trade of India with that of the sea-borne trade. What does the former consist of? Name the countries carrying on this trade.

10. Name and compare the principal means of communication in India.

11. Which are the strategic railways in India? In which parts are they chiefly met with and why?

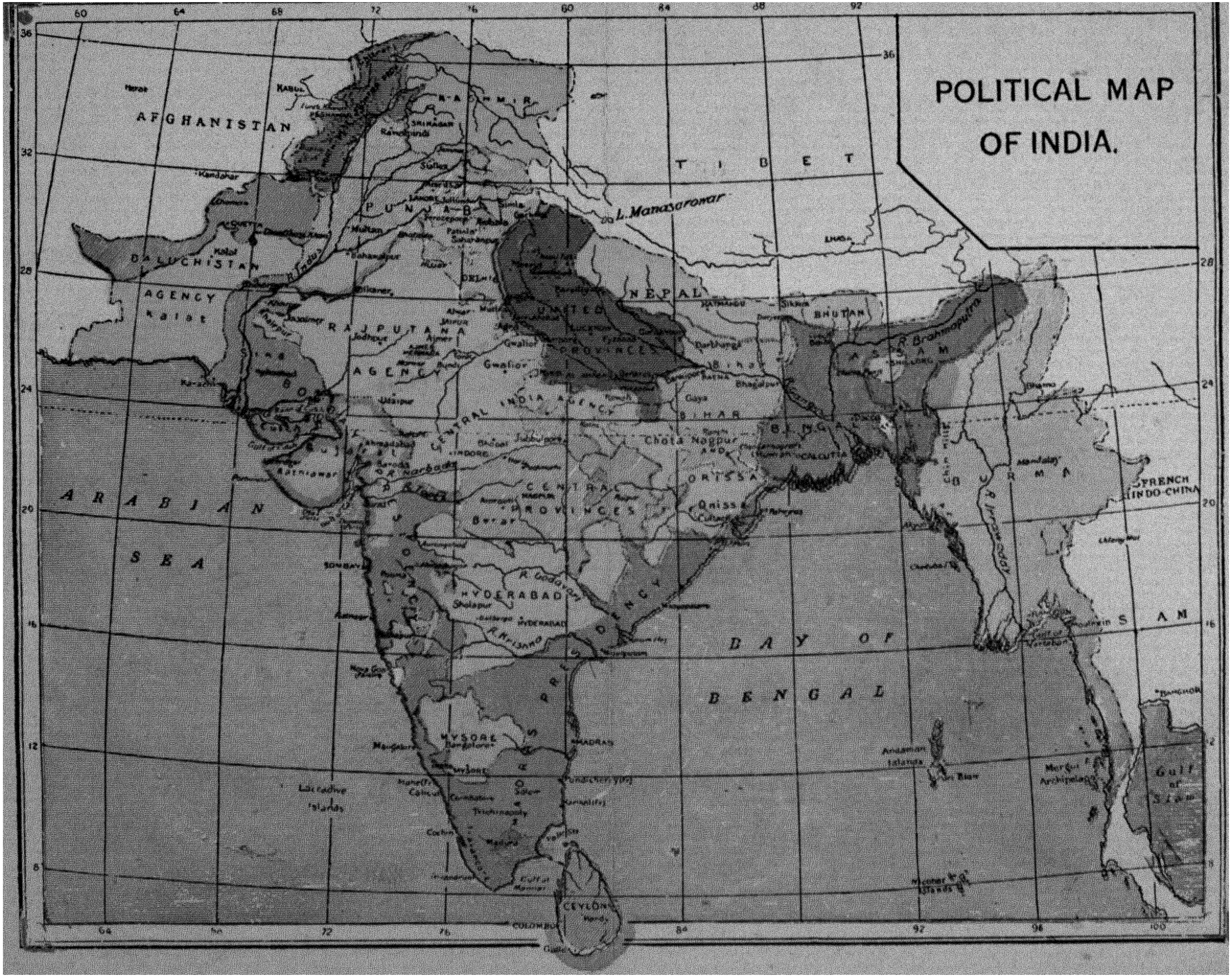
12. Describe the principal railways of India, giving their routes and the important stations.

13. Give a short account of the railway lines newly

opened or under construction in the Punjab and the North-West Frontier Province.

14. Why are the railways so numerous in the Indo-Gangetic plain, and so few in western Rajputana?

15. Draw a map of India showing (*a*) the principal railways, and (*b*) the distribution of population.



POLITICAL MAP OF INDIA.

CHAPTER XXVIII.

INDIA—POLITICAL DIVISIONS AND CHIEF TOWNS.

Government. India is a dependency, as distinguished from a dominion or a colony, in the British Empire. The supreme authority in India is the Governor-General or Viceroy in Council., subject to the direction of the Secretary of State and his Council in England. The Governor-General is assisted by an Executive Council in India consisting of seven members. The Governor-General and the members of his Executive Council are appointed by the Crown, generally for five years. The Indian Legislature consists of the Governor-General and two bodies, *viz.*, the Council of State and the Legislative Assembly. The Council of State consists of 60 members, of which 33 are elected and 27 nominated. The Legislative Assembly consists of 145 members, of whom 104 are elected and 41 nominated. The normal lifetime of each Council of State is five years, and of each Legislative Assembly three years. The members of the Governor-General's Executive Council are not *ex-officio* members of either Chamber, but each of them has to be appointed a member of one or other Chamber, and can vote only in the Chamber of which he is a member.

Administration. India is composed of British territory and Native States. British India for administrative purposes is divided into 15 provinces, each with its separate Local Government or Administration. The 15 provinces are—(1) Madras, (2) Bombay, (3) Bengal, (4) the United Provinces of Agra and Oudh, (5) the Punjab, (6) Bihar and Orissa, (7) the Central Provinces, (8) Burma, (9) Assam, (10) Ajmer-Merwara, (11) Coorg, (12) the North-West Frontier Province, (13) Baluchistan, (14) Delhi, and (15) Andamans and Nicobars. Each of the first nine provinces is governed by a Governor with an Executive Council of not more than four members and two or more ministers, each answerable to the Legislative Council. The remaining six provinces are directly administered by chief commissioners. These are merely the agents of the Central Government of India, whose headquarters are at Delhi, now called New Delhi.

Government and Administration of the Punjab. By the Indian Reform Act of 1919 the Punjab has been raised from a Lieutenant-Governorship to the status of a Governorship, with an Executive Council of two members, and three Ministers. The Governor in Council is in charge of the Reserved Subjects, such as police and famine, and the Governor acting with his Ministers is in charge of the Transferred Subjects, the more important of which are Local Self-Government, Medical Administration, Public Health, Education, Public Works, Agriculture, Excise and Industries. Associated with the Governor and the Council and Ministers is a Legislative Council which consists of 94 members, of whom 71 are elected and 21 nominated; 2 are *ex-officio* members.

The business of government is carried on by the Secretariat which consists of five Secretaries, namely, (1) Chief, (2) Home, (3) Finance, (4) Revenue, and (5) Secretary for Transferred Subjects. In the Public Works Department there are also three Secretaries, one in the Buildings and Roads Branch and two in the Irrigation Branch. The heads of the Police and Educational Departments are also Under-Secretaries to Government. Under the Governor the province is administered by five Commissioners for Ambala, Jullundur, Lahore, Rawalpindi and Multan, under whom are 29 Deputy Commissioners, each in charge of a district.

Justice is administered by a High Court, which is the final appellate authority in civil and criminal cases. The court is composed of a Chief Justice and six puisne judges and four additional judges. Subordinate to the High Court are 22 District and Sessions Judges, each of whom exercises civil and criminal jurisdiction in a civil and session division comprising one or more districts.

Order is maintained by the Police, which is divided into District and Railway Police. The combined force is under the control of the Inspector-General, who has under him four Deputy Inspector-Generals, one of whom is in charge of the Criminal Investigation Department. Each district is in charge of a Superintendent who is assisted by one or more Deputy Superintendents.

Local Self-Government is carried on by District Boards, Municipal Committees, Small Town Committees, Notified Area Committees and Panchayats. Of these the first four exercise authority over an urban area, while the last one—the Panchayats—holds authority over villages. There are 107 municipalities.

Native States. These number nearly 700 and vary in size from petty states with an area of a few square miles to states like Hyderabad with an area of about 83,000 square miles. Again, they include such desert regions as Western Rajputana and such favoured spots as Kashmir. They have a total area of 711,000 square miles, or more than a third of the area of the Indian Empire. The British Government does not interfere with their internal affairs, but in matters of imperial concern it gives advice through political officers, called Residents in large States and Agents in groups of small States.

The most important States are Hyderabad, Mysore, Travancore, Baroda, Rajputana Agency (containing Udaipur or Mewar, Jodhpur or Marwar, Jaisalmer, Jaipur, Bharatpur, Bikaner, Alwar, Tonk, Bundi, etc.), Central India Agency (containing Gwalior, Indore, Bhopal, Rewa, Ratlam, etc.), Punjab States (comprising Bahawalpur, Chamba, Faridkot, Jind, Kapurthala, Malerkotla, Mandi, Nabha, and Patiala), Kashmir, Sikkim, Bhutan, and Nepal. The last two are independent.

Foreign Possessions. Of foreign powers only France and Portugal hold possessions in India; these are all small territories on the coast.

French Possessions comprise five settlements:—(1) Pondicherry, (2) Karikal, (3) Yanaon, (4) Chandarnagar, (5) Mahé. The first four lie on the east coast, while the last is situated on the Malabar coast. They aggregate 203 square miles and have a total population of 284,432 (1927). The military command and administration-in-chief of the French possessions in India are vested in a Governor who resides at Pondicherry, the capital. He is assisted by a Chief Justice and by several other officials. Chandarnagar, Yanaon, Mahé and Karikal are each under an administrator. Local Councils and a Council-General have been in existence since 1879.

Portuguese Possessions consist of (1) Goa on the Malabar coast, (2) Daman on the Gujarat coast, and (3) Diu, a little island at the southern extremity of the Kathiawar Peninsula.

Chief Towns. The principal ports of India have already been considered under *Coast and Surroundings* (see chapter XXIII). We have now to consider the chief towns of the interior.

Peshawar, the capital of the North-West Frontier Province, owes its importance to its position. Situated at the head of the Khyber Pass, it commands the main route to Kabul. It is therefore a large military station and a great centre of trade beween the Punjab and Afghanistan. With the opening of the Khyber Railway in 1925 its importance has much increased.

Quetta, the capital of British Baluchistan, stands at the head of the Bolan Pass. It is therefore a fortified place, guarding the western entry to India by way of this pass. It is also an important centre of trade in fruits, wool, and carpets, between Persia and the Punjab. A railway line from Quetta to Nushki and Duzdap has recently been opened. The other fortress cities between Peshawar and Quetta guarding the north-west frontier of India are Kohat, Bannu, and Dera Ismail Khan.

Rawalpindi is situated east of the Indus on the highway from Peshawar to Delhi, and is the most important military centre and arsenal in Northern India. Being connected by strategic railways with Peshawar and Kohat it can send troops to these places in case of emergency. As a route leads to Srinagar, it is an important centre of trade between Kashmir and the Punjab. Other large military stations in the Punjab are Attock, Sialkot, Lahore Cantonment, Jullundur, Ambala, Ludhiana, and Ferozepore.

Lahore, the old and present capital of the Punjab, is a city of great historic interest. It is situated on the left bank of the Ravi and near the centre of the province. It is on the great Calcutta-Peshawar trunk route and also on a railway line which runs south-west to Karachi; it is therefore an important railway centre. It is the largest city in the province and has a University and numerous colleges.

Amritsar, about 30 miles east of Lahore, is the commercial capital of the Punjab. It manufactures carpets and shawls, and carries on a large business in piece-goods and hides and skins. It is the centre of Sikhism in India. Its famous Golden Temple, standing in a large tank, attracts visitors from far and near.

Multan, situated on the margin of the Thar desert, is a very old city of historic importance. Being on the line to Karachi, it collects the wheat, cotton and oilseeds grown in the Punjab for export abroad. It manufactures carpets and pottery, and is the meeting-place of important trade routes. For these reasons it is the largest town of southern Punjab.

Sargodha and Lyallpur are new towns, each situated in the midst of a canal colony. They serve as collecting centres of the agricultural produce of the surrounding regions and they export wheat, cotton, and oilseeds. They have attracted settlers from all parts of the Punjab and are rising rapidly in importance.

Simla, situated at a height of over 7,000 feet on the southern slopes of the Siwaliks, is the summer capital of both the Central Government and the Punjab Government. It is reached by a railway from Ambala through Kalka. Other important hill stations in the Punjab are Dalhousie, Dharmsala, Kasauli, and Murree.

Srinagar, on the Jhelum, lies in a beautiful valley and is the summer capital of the Maharaja of Kashmir. This picturesque old town is built almost entirely of wood, and owing to its bridges and canals it has been called the "Asiatic Venice." As it is the meeting place of routes to Rawalpindi, Gilgit and Leh, it is an important trade centre. It is famous for metal-work and the manufacture of shawls, carpets, and silk.

Gilgit, in the Gilgit valley, commands the pass to the north over the Hindu Kush and is therefore an important outpost in the extreme north-west. *Leh*, on the Indus in Ladakh, is the starting point of a trade route to Eastern Turkistan across the Karakoram pass. Shut in by the Himalayas from the monsoons of the south it is quite dry and therefore extremely cold in winter. In summer it is a fairly busy town, trading in brick-tea and costly silks.

Jammu is the winter capital of Kashmir, and is as yet the only place in the state reached by railway.

Delhi, on the Jumna, is the old and present capital of India. Standing midway between the Himalayas and the Thar desert it formed a gateway to all invaders marching towards the rich Ganges basin. It has been the scene of many of the most memorable events in Indian history. No city in the country has seen so much bloodshed as Delhi, round which lie the ruins of seven old Delhis. Since the transfer of capital from Calcutta to Delhi in 1911 a new city has been built near the old and is called New Delhi. Delhi contains several splendid buildings which speak of its former greatness. It is the chief railway junction of Northern India and an important trade centre, carrying on both the old industries of wood-carving and of gold and silver filigree work, and the modern industries of cotton-ginning, flour-milling and sugar-making.

Agra, founded by Akbar and adorned by Shah Jahan, is the old Moghul capital. It is famous for its Taj Mahal, which is the most beautiful building in the world. It is, besides, an important railway and trading centre.

Allahabad (Prayag), at the confluence of the Ganges and the Jumna, is the capital of the United Provinces of Agra and Oudh. It owes its importance both in old and modern times to its position. Situated at the junction of two sacred and navigable rivers it has always been a holy place to the Hindus and an important centre of river traffic. Lying halfway between Calcutta and the Punjab and in the midst of the Ganges basin, it is a great railway, trading, and educational centre.

Benares (Kashi), a city of ghats and temples, is the religious centre of the Hindus. Situated on the sacred Ganges it attracts thousands of pilgrims from all parts of India. Being the centre of a large fertile region, it is an important railway junction and place of trade. It is also noted for its old industries, such as brassware, jewellery, embroidery, silk cloth and toys.

Cawnpore, on the Ganges, is, unlike most other towns of the United Provinces, a modern town. It is the most important manufacturing and industrial town in the province. Its factories produce very large quantities of leather, cotton, and woollen goods. The city also has flour, sugar and paper mills, iron foundries, bristle factories, and chemical works. Besides, it is an important railway junction and a convenient distributing centre for the imports of Manchester piece-goods, hardware, and machinery, from both Bombay and Calcutta.

Lucknow, on the Gumti, is the capital of Oudh. As it was also the capital of the Kingdom of Oudh during Mohammedan times, it has many historical buildings which bear silent testimony to its former greatness. It still carries on the old court industries of gold, silver, glass, and ivory work. It is now a railway junction and an important military station, and has a University. Other important towns in the United Provinces are: *Hardwar,* which is sacred to the Hindus; *Aligarh,* which is the centre of Muhammedan learning in India; *Bareilly,* which is a large military station; *Moradabad,* which is famous for the manufacture of brassware and metal utensils; *Mirzapur,* which is a great grain, cotton, and shellac, market; and *Meerut,* which is a large cantonment. The principal hill stations are *Mussoorie* and *Nainital.* The large number of towns in this region is due to its great fertility and density of population.

Patna is the capital of Bihar and Orissa. Standing at the confluence of the Ganges, the Ghagra, the Gandak, and the Son, it was formerly the natural meeting-place of the traffic of these rivers and therefore a great centre of trade. With the building of railways its importance has decreased. Its chief industry is the manufacture of Government opium. *Bankipur* and *Dinapur* are respectively the civil and military stations of Patna. *Gaya,* south of Patna, and *Puri* on the coast are sacred places of Hindu pilgrimage.

Howrah, like Cawnpore, is a modern town of recent growth. It stands on the Hugli opposite Calcutta, with which it is connected by a bridge, and of which it may be regarded as a suburb. Being the terminus of the East Indian and Bengal-Nagpur Railways on the one side and the head of the ocean trade on the other, its internal and foreign trade is enormous. On account of the nearness of the jute-growing area and of the Jherria and Raniganj coalfields it has jute mills, iron foundries, and other important factories

Darjeeling, situated like Simla at a height of over 7,000 feet on the Himalayas, is an important hill station and the summer capital of the Bengal Government. It is reached by a narrow gauge railway from Calcutta. It is also important for the production and export of tea.

Dacca, on a distributary of the Brahmaputra, was once famous all over the world for the manufacture of fine muslins, but owing to the competition of cheap machine-made Manchester goods, only a small colony of muslin-weavers still survives. It was also important as being the capital of a large Mohammedan kingdom. At present it is a comparatively small town, carrying on trade in jute.

Shillong, nearly 5,000 feet above sea level, is an important hill station and the capital of the Assam Government. Assam, being a mountainous country, has a sparse population and therefore few towns of any size.

Nagpur, in the Central Provinces, is the capital of that province and has a University. Being situated on the railway line between Calcutta and Bombay and at the junction of the Great Indian Peninsula and Bengal-Nagpur Railways it is commercially important. Owing to the supplies of cotton and coal in the surrounding region, it has prosperous weaving mills, cotton ginning, and cotton pressing factories.

Jubbulpore, standing at the junction of the Great Indian Peninsula Railway from Bombay and the East Indian Railway from Allahabad, is one of the most important railway stations in India. It contains a large railway workshop, a gun factory, and a number of spinning and weaving mills, pottery works, and oil and flour mills.

Amraoti is the centre of the cotton industry in Berar.

Hyderabad, standing in a strategic position among picturesque scenery, is the capital of the Nizam's Dominions, which form the largest Native State in the Indian Empire. It is the fourth largest city in India, having a population of over 400,000.

Secunderabad, a little to the north of Hyderabad, is the largest military station in India.

Golkanda, seven miles from Hyderabad, was once famous for its diamonds. *Ajanta* and *Ellora,* in the north-west corner of the state, are famous places of archæological interest on account of their rock-cut caves and temples.

Bangalore, in Mysore, is the largest city of that State. Situated at a height of about 3,000 feet and open to both monsoons it enjoys a very pleasant climate. It is an important commercial centre, its chief manufactures being carpets, cotton textiles, woollen goods, and leather.

Mysore, the capital, and *Kolar* with its gold fields, are other important towns in the state.

Trichinopoly, at the head of the Cauvery delta in the Madras Presidency, is an important railway centre. Owing to the production of excellent tobacco near it, it is the centre of the cigar-making industry. It is also famous for a temple built on a rock about 300 feet high.

Madura and *Tanjore* are other places having great temples. The former, corresponding to Benares in the north, is the religious centre in the south, while the latter is the centre of a rich district. *Ootacamund,* about 7,000 feet high, is the summer capital of the Madras Government.

Poona, lying east of the Western Ghats at a height of 1,800 feet above sea level, is the ancient capital of the Mahrattas. It is now the summer capital of the Bombay Government and a large military station.

Ahmedabad, on the Sabramati, was the capital of Gujarat and one of the finest cities of India during Mohammedan times. It then manufactured articles of cotton, silk, silver, gold, and wood. It is now, next to Bombay, the most important cotton manufacturing centre in the Presidency of Bombay.

Sholapur in the south is another important centre for the manufacture of cotton. The chief inland towns of Sindh are *Haidarabad,* which is its former capital; *Shikarpur,* which is the starting point of a trade route to Persia and Baluchistan; *Sukkur,* which has a fine suspension bridge connecting Karachi with Quetta; and *Jacobabad,* which is the hottest place in India.

The chief towns in Rajputana and the Central India Agency are *Jaipur, Udaipur. Jodhpur, Chitor, Indore,* and *Gwalior*—all capitals of the states of the same name. Jaipur, surrounded by hills crowned with forts, with the palace in the middle, and with finely laid out bazaars lined by marble buildings, is one of the best planned cities of India. It is sometimes called the " Paris of the East."

The Future of India. From this survey of India we see how the great natural features of the country have shaped her long history and will continue to affect her progress. Her majestic heights, her noble rivers, her wide plains, her rich soil, her varied climate, her luxuriant vegetation, have from the earliest times made agriculture her chief industry. And though she is now becoming one of the foremost countries of the world in trade and manufactures her prosperity will still depend largely on the labours and welfare of her agricultural workers, who have always been the true wealth producers of India. Much has been done to improve agriculture, irrigation, railways, roads, manufactures, sanitation, and popular education. But a great deal more remains to be done to develop the natural and human resources of this vast country. The best guarantee of her further progress is, as the Viceroy has said, that men of every race and class and creed should unite in a single high resolve to guide India to fashion her future well.

Exercises.

1. Write a short note on the government and administration of India.

2. Name the principal Native States of India. What are their relations to the British Government?

3. What geographical factors have given importance to each of the following:—

Peshawar, Bombay, Allahabad, Multan, Sargodha, Srinagar, and Sukkur.

4. Describe fully the relative advantages of Delhi and Calcutta as the capital city of India.

5. Name and locate the principal hill-stations of India.

6. Locate the most important military stations of India. Why are they chiefly found on the North-West Frontier?

7. Howrah and Cawnpore are towns of modern growth. What factors have contributed to their growth and importance?

8. Why is it that there are so many large towns in the United Provinces, while there are so few in Assam?

9. Name some of the most important railway junctions of India. What principal lines meet at each of them?

10. Indicate the situation and importance of the following:—

Hardwar, Hyderabad, Bangalore, Poona, Ahmedabad, Agra, Rawalpindi, Amritsar, Benares, Aligarh and Amraoti.

CHAPTER XXIX

CEYLON AND OTHER ISLANDS IN THE INDIAN OCEAN.

CEYLON.

Position, Shape and Size. Ceylon, or the Lanka of the Hindus, is a large island situated to the south of India. It is only 22 miles apart from the mainland, with which it is almost connected by the islands of Mannar and Rameswaram, and a ridge of sand-banks, called *Adam's Bridge*. It once formed part of the Deccan, from which it is now separated by Palk Strait and the Gulf of Mannar. Both these are so shallow that ships cannot pass through them, but have to go round the Island. In shape Ceylon is like a pear, with its point to the north. Its area is about 25,000 square miles and the greatest distance from north to south is 270 miles.

Physical Features. Ceylon consists of a central mass of mountains, surrounded by a broad coastal plain, which is low in the north. The highest mountain is *Pedrotolagala* which is more than 8,000 feet high. *Adam's Peak,* another lofty mountain, is famous for a footprint borne on its top and believed to be that of the Buddha. It is held sacred by the Buddhists and is used as a place of pilgrimage by them. Rivers are short and rapid and run in all directions. The principal one is the *Mahawali Ganga* which flows to the north and is about 150 miles long.

Climate and Rainfall. Ceylon is situated between

6° N and 10° N. Thus as it is situated very near the equator, it is very hot, but the great heat is tempered by the sea which surrounds it. The interior is cooler on account of elevation. The climate is therefore equable ranges of temperature.

Like India, Ceylon gets its rainfall from both the monsoons. The south-west monsoons bring rainfall to the west and the south-west, while the north-east monsoons give rain to the north-east coast and eastern slopes of the mountains. As the northern part of the island has no hills to check the winds, it is dry. Thus the all the year round, with very small daily and annual climate on the whole is hot, moist and equable.

Products and Industries. As both heat and rainfall are great, vegetation is luxuriant. The lower slopes of the mountains, which receive heavy rainfall, were once covered with thick forests. These forests have now been cut down to make room for rubber plantations and tea gardens. Rice, coco-nuts and spices, such as cinnamons, cardamoms, cloves and pepper, are extensively grown. From the husk of coco-nuts coir is obtained. The kernel is dried for export as copra, from which coco-nut oil is extracted. Fishing is an important industry round the coast. Pearl fishing is carried on in the warm shallow waters of the Gulf of Mannar. Ceylon is rich in precious stones and graphite. The latter is used for making lead pencils.

Commerce and Communications. The principal exports are tea, rubber, copra, coir, coco-nut oil and cinnamon. All of these go to Great Britain, except rubber which goes to Great Britain and the United States. The chief imports are rice, cotton goods, coal and coke, and sugar. Rice is the staple food of the people, but the mountainous island cannot grow enough to feed the entire population. Sugar comes mainly from Java.

A railway line runs inland from Colombo, with branch lines to Galle in the south and Jaffna in the north. The railways of Ceylon and India are now connected by a line which has been built along the reefs of Adam's Bridge. The island has many excellent roads.

People and Religion. There are about five million people in Ceylon. The principal race is the Sinhalese, who are Buddhists by religion. The Tamils, who are Hindus, are settled in the north. The Moors, who originally came from North Africa, are Mohammedan traders and fishermen. There are also some Burghers, or the descendants of the old Portuguese and Dutch settlers.

Government. Though Ceylon is geographically a part of India, yet politically it is separate from it. It was made a Crown Colony in 1802, and is ruled by a Governor who is aided by an Executive Council, with a Legislative Council consisting mostly of elected members.

Chief Towns. *Colombo* is the capital of Ceylon. It has a fine artificial harbour, protected from the south-west monsoon by a great breakwater. It is not only the principal port of Ceylon, but as it is situated at the head of the Indian Ocean and on a great ocean highway from Europe to the Far East, it is also a great sea junction where routes from south, east and west meet. Hence it is one of the greatest coaling stations in the world. As railways radiate from it to Kandy and other principal places in the island, it is also a great railway junction.

Galle in the south has a fine natural harbour and is the second seaport in the island. *Kandy*, the old capital, is reached by a wonderful hill-railway from Colombo. *Nuwara Eliya* is an important hill station. *Trincomalee*, on the north-east coast, has a fine large natural harbour, but as its hinterland is sandy and unpopulated, the port is not important. *Jaffna,* situated on the peninsula of the same name, is an important town in the north.

THE MALDIVE ISLANDS.

The Maldive Islands lying about 400 miles south-west of Ceylon are coral islands. They form a dependency of Ceylon. They are governed by a Sultan who pays a nominal tribute to the Ceylon Government. There are about 70,000 inhabitants, who are Musalmans by religion. They are civilized and are great traders. The islands are richly clothed with coco-nut palms. Coco-nuts, fish and cowrie-shells are the principal exports.

THE LACCADIVE ISLANDS.

The Laccadive Islands are a group of coral islands, lying about 200 miles to the west of Malabar coast. They are under the Madras Government. The population consists of nearly 13,000 people, who are Mussalmans by religion. The chief product is the coco-nut, from which coir and copra are obtained.

THE ANDAMAN ISLANDS.

The Andaman Islands lie in the Bay of Bengal, 120 miles from Cape Negrais in Burma, which is the nearest point on the mainland. They form part of a submarine ridge which sweeps from Cape Negrais to the East Indian Archipelago. They consist of six large islands and some 200 islets. Their total area is 2,508 square miles.

Situated in the midst of the Indian Ocean, they receive heavy rainfall and are therefore densely wooded. The forests yield valuable timber, Coco-nut, rubber and manila hemp are also cultivated. The native inhabitants are savages of a Negro type. The chief town is Port Blair, which is used as a penal settlement for British India. These islands are under the charge of a Chief Commissioner, who is under the Government of India.

THE NICOBAR ISLANDS.

The Nicobar Islands are situated 75 miles further south. Like the Andamans they form part of the submarine ridge which extends from Cape Negrais to the East Indies. Coco-nut is the principal product. These islands are administered by the Chief Commissioner for the Andamans.

EXERCISES.

1. What do you know about the position of Ceylon? How do we know that it was once connected with the Deccan?

2. Describe briefly the physical features of Ceylon. Why is Adam's Peak sacred to the Buddhists?

3. Give a short account of the climate and rainfall of Ceylon. In what seasons does Ceylon get rainfall?

4. What are the principal products of Ceylon? Name the articles of export and import.

5. Write short notes on the following:—
Colombo, Kandy, Trincomalee, Nuwara Eliya, Adam's Bridge.

6. Geographically Ceylon is a part of India; politically it has no concern with it. Account for these facts.

7. Ceylon is sometimes called the "Pocket Edition of Peninsular India." Explain this statement.

8. Explain why coco-nut is the most important product in Ceylon and other Indian Ocean islands.

9. What use does the Indian Government make of the Andaman Islands ?

10. The Andamans and the Nicobars form part of a submarine ridge which extends to the East Indies. What conclusion do you draw from this ?